Common Criteria for Information Technology Security Evaluation

Department of Defense Public Key Infrastructure Token Protection Profile

Version 2.0
12 March 2001

Prepared by Booz·Allen & Hamilton Inc.

Prepared for National Security Agency (NSA)
Information Assurance Research Organization (IARO)
Identification and Authentication Research Branch (IARB)
And the Department of Defense Public Key Infrastructure
Program Management Office

Report Documentation Page

Report Date	Report Type	Dates Covered (from... to)
12032001	N/A	-

Title and Subtitle Department of Defense Public Key Infrastructure Token Protection Profile	**Contract Number**
	Grant Number
	Program Element Number
Author(s)	**Project Number**
	Task Number
	Work Unit Number
Performing Organization Name(s) and Address(es) Booz Allen & Hamilton 8283 Greensboro Drive McLean, VA 22102	**Performing Organization Report Number**
Sponsoring/Monitoring Agency Name(s) and Address(es) BAH	**Sponsor/Monitor's Acronym(s)**
	Sponsor/Monitor's Report Number(s)
Distribution/Availability Statement Approved for public release, distribution unlimited	
Supplementary Notes	
Abstract	
Subject Terms IATAC COLLECTION	
Report Classification unclassified	**Classification of this page** unclassified
Classification of Abstract unclassified	**Limitation of Abstract** UU
Number of Pages 134	

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 074-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	3/12/2001	Publication 3/12/2001

4. TITLE AND SUBTITLE
Department of Defense Public Key Infrastructure
Token Protection Profile

5. FUNDING NUMBERS

6. AUTHOR(S)
BAH

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Booz Allen & Hamilton
8283 Greensboro Drive
McLean, VA 22102

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

BAH

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited

12b. DISTRIBUTION CODE
A

13. ABSTRACT *(Maximum 200 Words)*

This protection profile (PP) was developed to identify and set forth the security requirements for a Department of Defense (DoD) Public Key Infrastructure (PKI) Token based on Version 2.1 of the "Common Criteria," International Standard 15408. The Common Criteria can be found at http://www.csrc.nist.gov/cc.

14. SUBJECT TERMS
IATAC Collection, Department of Defense
Public Key Infrastructure
Token Protection Profile, PKI

15. NUMBER OF PAGES

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UNLIMITED

Foreword

This protection profile (PP) was developed to identify and set forth the security requirements for a Department of Defense (DoD) Public Key Infrastructure (PKI) Token based on Version 2.1 of the "Common Criteria," International Standard 15408. The Common Criteria can be found at http://www.csrc.nist.gov/cc.

Comments on this PP should be e-mailed to Tamara Cleveland at cleveland_tamara@bah.com.

Table of Contents

List of Tables and Figures

1 Introduction

This protection profile (PP) is the result of work done by the National Security Agency (NSA) with guidance from the Department of Defense (DoD) community. It is based on the S*mart Card Security User Group Smart Card Protection Profile*, Draft Version 2.0, May 1, 2000.

The structure for this PP was established through the use of the Common Criteria Toolbox (version 5.0, 28 February 2000). This toolbox was developed by SPARTA, Inc., for the NSA. It is available at http://cctoolbox.sparta.com.

A token compliant with this PP may offer security features and functionality beyond that specified in this PP.

1.1 Identification

Title:	Department of Defense Public Key Infrastructure Token Protection Profile
Authors:	Tamara Cleveland, Booz·Allen & Hamilton Inc. Michael Alexander, Booz·Allen & Hamilton Inc. Asok Ganguly, Booz·Allen & Hamilton Inc. Brian Green, Booz·Allen & Hamilton Inc. Edward Schneider, Institute for Defense Analyses
Vetting Status:	N/A
CC Version:	2.1 Final
Registration:	N/A
Keywords:	DoD PKI, token, smart card

1.2 Protection Profile Overview

This PP specifies the information technology (IT) security requirements for a token to be used with sensitive but unclassified (SBU) applications (Class 4) in the DoD Public Key Infrastructure (PKI). The services provided by the DoD PKI include the generation, distribution, control, tracking, and destruction of public key certificates. The DoD PKI's primary goal is the secure transport of sensitive but unclassified or unclassified information using unprotected networks. The DoD PKI token carries public key certificates used to authenticate its user in public key transactions and applications.

The security requirements in this PP apply to the DoD PKI token as issued to the token holder. These requirements cover the token's integrated circuit, operating software, and specific applications when processing DoD information. This PP does not cover security requirements for token terminals or networks interfacing with them. Throughout the requirements section in this protection profile, references are made to requirements for FIPS 140-2 Level 2 for Subscribers/Level 3 for Registration Authorities and Certificate Authorities. If the DoD Common Access Card (CAC) issuing infrastructure is not capable of issuing two different levels of cards, then all CACs will be required to meet FIPS 140-2 Level 3.

Appendix A lists references, and Appendices B and C, respectively, list acronyms and a glossary of terms used in this PP.

1.3 Assurance Level

The assurance level for this PP is EAL4 augmented. Augmentation results from the selection of ADV_CMM.1 and AVA_VLA.3.

1.4 Related Standards and Documents

Additional input was derived from the following security documents furnished by the NSA:

Consideration of Smart Cards as the DoD PKI Authentication Device Carrier, 10 January 2000.
DoD Target Token Requirements Document, (Draft), 8 March 2000.
Public Key Infrastructure Target Class 4 Token Security Requirements, Draft version 1.01, April 10, 2000.

Standards that were referenced during the development of this PP include:

Draft FIPS 140-2, *Security Requirements for Cryptographic Modules*, 1999.
ISO 7816, *Identification Cards - Integrated Circuit Cards with Contacts*.
X.509 Certificate Policy for the U. S. Department of Defense, version 5.2, 13 November 2000.

1.5 Related Protection Profiles

This PP was developed using as a foundation the *Smart Card Security User Group Smart Card Protection Profile* (SCSUG-SCPP) Draft Version 2.0 (May 1, 2000). The SCSUG-SCPP can be found at http://csrc.nist.g.cov/cc/sc/sclist.htm.

The SCSUG-SCPP was examined for possible use as the PP for the DoD PKI Token. The SCSUG-SCPP defines security requirements for commercial smart cards used for sensitive applications, such as banking industry financial payment systems. The SCSUG-SCPP allows several of its requirements to be specified in the vendor's security target documentation. The DoD PKI Token will be used for applications that are unique to the DoD environment. Furthermore, several of the requirements for this token need to be more explicit than those for the smart cards described in the SCSUG-SCPP. Thus, this protection profile was developed in lieu of using the SCSUG-SCPP in order to address the DoD PKI Token's applications and to add specificity to its security requirements.

1.6 PP Organization

Section 1 provides the introductory material for the protection profile.

Section 2 provides the general purpose of the protection profile and the Target of Evaluation (TOE) description.

Section 3 provides a discussion of the expected environment for the TOE. This section also defines the set of threats that are to be addressed by either the technical countermeasures implemented in the TOE hardware or software or through the environmental controls.

Section 4 defines the security objectives for both the TOE and its environment.

Section 5 contains the functional and assurance requirements derived from the Common Criteria, Parts 2 and 3, respectively, that must be satisfied by the TOE.

Section 6 provides rationale to explicitly demonstrate that the information technology security objectives satisfy the assumptions, policies, and threats. Arguments are provided for the coverage of each assumption, policy, and threat. The section then explains how the set of requirements are complete relative to the objectives, and that each security objective is addressed by one or more component requirements. Arguments are provided for the coverage of each objective. The Evaluation Assurance Level (EAL) is then presented with its supporting assurance requirements. Next, Section 6 addresses dependency analysis and strength of function issues.

The Appendices contain references, an acronym list, a glossary, a description of token states, comparisons to the SCSUG's PP, and additional threat information.

2 TOE Description

2.1 Token Overview

A token is used to store and carry cryptographic keys and certificates supporting user identity authentication. There are various types of tokens including smart cards, universal serial bus (USB) tokens, Personal Computer Memory Card International Association (PCMCIA) cards, and iButtons®/Java Rings®. The DoD Token will contain an integrated circuit (IC) and an operating system.

A semiconductor (silicon) IC is fabricated in a complex microelectronic process, which involves repeatedly masking and doping the surface of a silicon substrate to form transistors, followed by patterning metal connections, and applying a protective overcoat. This process eventually yields a design typically comprising several hundred thousand transistors, arranged in an area of less than 25 square millimeters. The design consists of a central processing unit, input and output lines, and volatile and nonvolatile memory.

The IC itself is packaged in a token. The current predominant packaging method is die bonding in a module. A module consists of a carrier board on which the IC is seated. Wire bonds are connected from the IC's input/output (I/O) pads to the carrier, which has contacts on its reverse side.

The token also contains an operating system that may be stored in Read Only Memory (ROM). The DoD Token's operating system will allow authorized applications to be added to the token. Examples of operating systems are MultOS®, Java Virtual Machine®, and Smart Cards for Windows® with MEL®, Java®, and Visual Basic® as their programming languages, respectively.

2.2 Types of Tokens

A smart card is a credit card-sized token that often has a microprocessor on its IC. In a smart card, the IC is encapsulated in a protective material (usually some type of epoxy), and this module is adhesively embedded into a premilled hole in a plastic card. Two common examples are the familiar payment card-sized smart cards and the smaller postage-stamp-sized subscriber identity module (SIM) frequently used in mobile telephones. Smart cards communicate with the outside world via a reader connected to a standard (e.g., serial, USB, or PCMCIA) interface in a contact environment or via radio frequency (RF) electromagnetic waves in a contact-less environment.

Categories of smart cards include:

• Contact Cards

- Memory only (sometimes with protection features)
- Microprocessor with memory
- Microprocessor with memory and additional coprocessor

• Contact-less Cards

- As above, but with power derived from energy obtained through a contact-less interface

A smart card serving as a DoD PKI token will have symmetric and asymmetric (i.e., public key) cryptographic algorithm capability. Asymmetric cryptography typically requires a math coprocessor. Additionally, the smart card will be able to hold multiple applications in separate protected areas on the card.

USB is an interface incorporating the high-speed external bus for PCs. A USB token is a device containing an embedded microprocessor IC that interfaces directly with a PC's USB port without any additional hardware, e.g., a card reader. The microprocessors used in USB tokens are just as powerful as those in smart cards.

A PCMCIA card is a hardware device that supports specific dedicated functions. Examples of PCMCIA card functions include memory devices, input/output devices (e.g., modems and fax modems), and portable disk drives. PCMCIA cards are most commonly used to provide additional computing features for portable computers such as laptops. NSA's FORTEZZA® Crypto Card is an example of a PCMCIA card. PCMCIA cards provide the strongest security and largest memory storage capacity of available tokens.

Dallas Semiconductor's iButton® is a computer chip encased in a 16-mm stainless steel case. It can be attached to articles of clothing, wallets, etc. A Java Ring® is a ring with an iButton® attached to it.

2.3 TOE Overview

The target of evaluation is the DoD PKI token. The DoD is implementing a PKI that will serve as a key and certificate management infrastructure designed to support confidentiality, integrity, availability, and authentication in computer networks. This PKI will require authentication devices (i.e., tokens) to store and carry cryptographic keys supporting user identity authentication. This token will be used for Class 4 applications, which refers to the assurance level intended for applications handling high value UNCLASSIFIED information (Mission Critical, National Security System Information) in a minimally protected environment.

The word “token,” as used in this PP, refers to the DoD PKI end-entity cryptographic hardware device that houses the DoD PKI private keys and associated public key certificates and algorithms. The TOE is an operational token platform, consisting of the integrated circuit and on-card operating software, including DoD-provided applications and the mechanisms that allow communication with the outside world. The TOE consists of sufficient hardware and software elements to be capable of establishing a secure channel to a trusted source for application loading or for other potentially privileged commands.

This PP does not include printing on the TOE, including printed security features such as holograms. This PP also does not apply to the terminal, non-DoD applications loaded onto the token, nor to any network with which the token interfaces.

2.4 Applications

The DoD PKI token allows for multiple applications to support the DoD mass population (i.e., all DoD military, civilian, and contractor personnel operating in the SBU environment). Security functions present will be of appropriate level and protection. Typical applications for tokens within the DoD include:

• Financial–Payment schemes may include credit, debit, and stored value functions provided by an electronic commerce (EC) application. The EC application is loaded onto the token and will probably require a public/private key to be used. The specific EC application (Visa/MasterCard, banking, electronic payment, etc.) will specify how that key is to be ordered and loaded.

• Secure Messaging–Secure Messaging, as it pertains to the DoD community, establishes requirements for an integrated common-user, writer-to-reader organizational, and individual messaging service accessible from DoD locations worldwide, tactically deployed users, and other designated Government users with interfaces to Allied users and Defense contractors. The DoD PKI Token will provide identification, authentication, and encryption functions for secure messaging. Specifically, the token technology combines encryption, digital certificates, and other PKI technologies to authenticate a user’s identity and to ensure that data and transactions are not tampered with during transmission.

• Identification–Various public and private schemes provide identification credentials to participants. The identification credentials are typically associated with various rights and duties defined by the identification provider. These can include memberships, driver’s licenses, benefit access, security access, passports, national identification, etc. Typically the identification credentials have value because the credential holder cannot easily alter them, and assets (e.g., user data and cryptographic keys) in the credential must be protected against alteration by the cardholder. Digital certificates used in public key systems fit into this category.

• Secure information storage–Information that is useful to store in a secure fashion includes health records, health insurance, medical information, etc.

• Access Control–Tokens can hold access credentials such as passwords, biometrics, and PINs that authenticate and verify a user's access to a building, a sensitive controlled area, and a computing environment and its applications (e.g., computer network, workstation, e-mail, or Web browser) containing personal or mission-critical data (that requires signing or encrypting data), or the right to be issued firearms/weapons.

Each of these may have somewhat different security requirements, security features, roles, and environmental considerations (e.g., whether always on-line, always used off-line, usually off-line with the capability of going on-line, etc.). The security requirements for operating software, applications, and procedures for adding or deleting those applications must therefore be clearly identified, and the security functions that are present must be appropriate to the type and intended use of the token.

2.5 TOE Identification

Through selection of the Configuration Management Class of assurance functions, this PP imposes the requirement that a unique reference be utilized to ensure that there is no ambiguity in terms of which instance of the TOE is being evaluated. Labeling the TOE with this reference ensures that users of the TOE are aware of which instance of the TOE they are using. The TOE described herein is, however, a combination of hardware and software, each portion of which may be composed of a further collection of components. This aggregate collection offers the potential for confusion in identifying a unique reference for the TOE.

To further complicate identification, an IC can usually be produced with multiple features, only some of which are enabled. The design layout of the IC (the photomask) determines the functionality; however, as fabrication technology improves, this photomask may be used to produce an otherwise identical chip but with a reduced feature size. Likewise, software features may be selectively employed, depending on hardware functions. However, the presence or absence of specific features may directly contribute to the possible introduction of vulnerabilities. For example, the size of the IC features is directly related to the relative difficulty of probing. A potentially unknown, but present, software feature may allow backdoors or other routes for penetration.

It is therefore essential that the unique reference for a TOE compliant with this PP must allow the identification of at least:

- the microprocessor specification
- the memory size and allocation (ROM, EEPROM, RAM, etc.)
- the physical instantiation of the IC design regarding layout and feature size
- all hardware security features on the IC, whether they are initially enabled or not
- all enabled hardware security features
- the software specification
- all software security features present, whether they are enabled or not
- all enabled software security features.

2.6 Cryptography

A variety of cryptographic keys are typically used with smart cards, including transport keys, personalization keys, application-specific keys, etc. Handling of these keys must be done in accordance with the DoD key management procedures and policies as specified in the Key Management and SSO Authentication Specification (see Appendix F).

Cryptography may be implemented in hardware or software, with various algorithms and various key lengths. Many tokens have dedicated cryptographic coprocessors that execute DES, triple DES, RSA, and other standard algorithms much faster than software implementations can. Some applications use no cryptography, some use private key, and some use public key systems.

Any TOE claiming compliance with this protection profile must handle cryptographic functions in accordance with applicable international, industrial, or organizational policies. This extends to any applications using cryptography, although there may be additional applications on the token that do not use cryptography at all.

2.7 Attacker Capabilities

Attackers are assumed to have various levels of expertise, resources, and motivation. Relevant expertise may be in general semiconductor technology, software engineering, hacker techniques, or the specific TOE. Resources may range from personal computers and inexpensive card-reading devices to very expensive and sophisticated engineering test and measurement devices. They may also include software routines, some of which are readily available on the Internet. Motivation may include economic reward, intelligence gathering by hostile nations, or notoriety of defeating high-grade security. Given sufficient time and expertise, any token can be compromised. The strength of function for a TOE based on this PP is medium. In the DoD, this refers to a minimum strength of mechanism level (SML) of 2 as defined in chapter 4 of the *Information Assurance Technical Framework*, which can be found at http://www.iatf.net/.

2.8 Description of Token States

Some states of the DoD PKI Token need to be defined to effectively describe the conditions under which some of the token security requirements apply. A detailed description of these token states is provided in Appendix D.

3 TOE Security Environment

This section identifies the following:

- Significant assumptions about the TOE's operational environment
- IT-related threats to the organization countered by DoD PKI Token PP compliant components
- Threats requiring reliance on environmental controls to provide sufficient protection
- Organizational security policies for which DoD PKI Token compliant TOEs are appropriate.

3.1 Secure Usage Assumptions

The specific conditions listed below are assumed to exist in the DoD PKI Token environment. Each assumption is stated in bold type font. Some assumptions are followed by an application note, in normal font, that supplies additional information and interpretation.

A.Dev_Protect: Protection of TOE by Developer

During the development and manufacturing process, the TOE and associated development tools are assumed to be protected by the developer from any kind of unauthorized use, e.g., tampering or theft.

A.Key_Gen: Key Exchange Key Generation

Key exchange keys are assumed to be generated off-TOE in a secure manner in accordance with X.509 Certificate Policy.

The Key Exchange Key is critical for secure communication with the host.

A.Role_Man: Role Management

Management of roles for the TOE is performed in a secure manner off-TOE.

The various roles involved in working with the TOE are established in the development and user community through the TOE manufacturers, card issuing bodies, etc. These roles will be managed off-card by these or other bodies. The TOE is required to recognize the defined roles, which is often done through the use of special (transport, personalization, initialization, etc.) keys, but the TOE is not required to support their management.

A.Secure_Host_Comms: Secure Host Communications

> **If the host establishes a secure connection between itself and the TOE that conforms to the requirements imposed by the TOE, the host, including code and security data it contains, is assumed to be trusted.**

> > The host may have the capability to establish a secure communication channel with the TOE. This is typically accomplished through shared private keys, public/private key pairs, and/or generation of local keys derived from other stored keys. When such a secure link is established, the TOE may assume the host to be adequately secure for trusted communications. The host is considered to be beyond the scope of this PP.

3.2 Threats to Security

DoD PKI Token PP compliant TOEs are required to counter threats that may be broadly categorized as:

- Threats addressed by the TOE:
  - Threats associated with physical attack on the TOE
  - Threats associated with logical attack on the TOE
  - Threats associated with control of access
  - Threats associated with unanticipated interactions
  - Threats regarding cryptographic functions
  - Threats that monitor information
  - Miscellaneous threats

- Threats addressed by the Operating Environment

Each threat is stated in bold type font. Most threats are followed by an application note, in normal font, that supplies additional information and interpretation. In parentheses, a code for the source of the threat statement is given. The key for the source codes is as follows:

SCSUG	Smart Card Security User Group's Smart Card Protection Profile
TSRD	Public Key Infrastructure Target Class 4 Token Security Requirements Document
NEW	Created by Token PP Team

3.2.1 Threats Addressed by the TOE

3.2.1.1 Threats Associated with Physical Attack on the TOE

T.E_Manip: Electrical Manipulation of the IC (SCSUG)

An attacker may utilize electrical probing and manipulating of the TOE to modify security-critical data so that the TOE can be used fraudulently.

This modification may include manipulation of debug lockouts, first-use indicators, token use blocking, blocking function configuration, token block indicators, or token disablement indicators. This threat is distinguished by the intent to utilize a modified TOE rather than to derive information from the TOE. The attacker may attempt to introduce faults in the TOE or change TOE assets (PIN or biometric data, user data, certificate information, private keys, etc.) to use the TOE in a fraudulent manner. This threat characterizes active threats. Refer also to T.Power_Clock, T.Forced_State_Change, and T.Env_Strs.

T.P_Modify: Physical Modification of the IC (SCSUG)

An attacker may physically modify the TOE in order to reveal design- or security-related information.

This modification may be achieved through techniques commonly employed in IC failure analysis and IC reverse engineering efforts. The goal is to identify such design details as hardware security mechanisms, access control mechanisms, authentication systems, data protection systems, memory partitioning, or cryptographic programs. Determination of software design, including initialization data, personalization data, passwords, or cryptographic keys, is also a goal.

T.P_Probe: Physical Probing of the IC (SCSUG)

An attacker may perform physical probing of the TOE to reveal design information and operational contents.

Such probing may include electrical functions but is referred to here as physical, since it requires direct contact with the chip internals. Physical probing may entail reading data from the chip through techniques commonly employed in IC failure analysis and IC reverse engineering efforts. The goal of the attacker is to identify such design details as hardware security mechanisms, access control mechanisms, authentication systems, data protection systems, memory partitioning, or cryptographic programs. Determination of software design, including initialization data, personalization data, passwords, or cryptographic keys is also a goal.

T.Power_Clock: Power and Clock (New [Assumption in SCSUG])

An attacker may interrupt, reset, or alter TOE power or clock to disrupt security-critical functions.

TOE power and clock may be provided by unreliable sources. The TOE is not internally powered, so support must be delivered to the card from the card acceptor device (CAD) or through an alternate connection to the TOE terminals. Both power and clock may be interrupted or reset in the normal course of business. The CAD is independent of the TOE and may belong to a different entity, which may be considered in some way hostile. Power may deviate from the design level (above or below) and may be supplied intermittently. The clock can likewise be manipulated. The intent of such manipulation may be to generate errors in the TOE operation, leading to a compromise of security.

3.2.1.2 Threats Associated with Logical Attack on the TOE

T.Bad_Load: Load Bad Software or Security Data (SCSUGmod of T. Load_Mal)

An attacker, an SSO, or the user may load improper software (operating system, executable files) or security data (authentication information, keys, access control information) onto the TOE that could modify or expose software (e.g., security functions) or data on the TOE.

During the stages of card preparation that involve loading the TOE with special keys, identification of roles, etc., the data itself may be changed from the intended information or may be corrupted. Either event could be an attempt to penetrate the TOE security functions or to expose the security in an unauthorized manner.

T.Component_Fail: Failure of a Critical System Component (TSRD)

An attacker exploits a failure of one or more system components, resulting in the loss of system-critical functionality.

This threat is relevant when there are components that may fail due to hardware and/or software imperfections and when the availability of system functionality is important.

The two basic engineering objectives to provide maximum securities are (a) minimize the probability of a security failure, and (b) minimize the consequences of failure. Usually, in chip cards all hardware components represent single points of failure (ROM, RAM, EEPROM, bus structure, microprocessor, etc.). Most failures occur where components designed by different people interact.

T.Developer_Flawed_Code: Software containing security-related flaws (TSRD)

An attacker exploits code delivered by a system or application developer that does not perform according to specifications, contains security flaws, or is not appropriate for operational use.

An important special case of this threat is when the security flaws prevent the system's security mechanism (TSF) from adequately protecting itself.

Various token OS developers, IC manufacturers, and token suppliers are involved in producing tokens. The number of different entities involved in the token development process creates a greater potential for security-related flaws to be introduced to the token.

T.Flt_Ins: Insertion of Faults (SCSUG)

An attacker may determine security-critical information through observation of the results of repetitive insertion of selected data.

Insertion of selected inputs followed by monitoring the output for changes is a relatively well-known attack method for cryptologic devices that can be applied to this TOE as well. The intent is to determine operational and security-related information based on how the TOE responds to the selected inputs. This threat is distinguished by the deliberate choice and manipulation of input data as opposed to random selections or manipulation of the physical characteristics involved in input/output operations. Manipulation may involve direct control of the I/O, clock, or power lines to generate security-critical information either directly or through inference.

T.Forced_State_Change: Forced State Change (SCSUGmod: T.Forcd_Rst)

An attacker may force the TOE into a nonsecure state through inappropriate termination of selected operations.

Attempts to generate a nonsecure state in the TOE may be through premature termination of transactions or communications between the TOE and the card-reading device, insertion of interrupts, or by selecting related applications that may leave files open.

T.Inv_Inp: Invalid Input (SCSUG)

An attacker or authorized user of the TOE may compromise the security features of the TOE through the introduction of invalid inputs.

Invalid input may take the form of operations, which are not formatted correctly, requests for information beyond register limits, or attempts to find and execute undocumented commands. The result of such an attack may be a compromise of the security functions, generation of exploitable errors in operations, or release of protected data.

T.Spoof: Spoofing Legitimate System Services (TSRD)

An attacker tricks users into interacting with spurious system services, e.g., an unauthorized (bogus) terminal, that request sensitive information from the TOE.

The attack method may involve writing software to spoof users or modifying message protocol information in transit.

T.UA_Use: Unauthorized Program Use (SCSUGmod: UA_Load)

An attacker may utilize unauthorized programs to penetrate or modify the security functions of the TOE.

Some commands and functions may be built into the TOE that are never utilized in the intended application(s). Use of these existing but unauthorized operations may be attempted to create a compromise in TOE security. This threat is distinguished by the use of commands that exist but are not used in any of the authorized operational modes of the TOE.

3.2.1.3 Threats Associated with Control of Access

T.First_Use: Fraud on First Use (SCSUG)

An attacker may gain access to TOE information by unauthorized use of a new, previously unissued TOE.

The process of issuance may involve setting of indicators in the TOE or notification by the TOE to the (external) issuing bodies that this specific TOE is now in operation. Attempts to use an unissued TOE without such mandated approval could result in fraudulent use.

T.Impers: Impersonation (SCSUG)

An attacker may gain access to TOE information by impersonating an authorized user of the TOE.

Impersonation may be accomplished through using a stolen TOE and spoofing the authentication mechanism(s). The TOE is required to allow certain roles be granted certain privileges. Impersonation of a user with such privileges could expose security functions or information that is to be protected by the TOE from unauthorized release.

3.2.1.4 Threats Associated with Unanticipated Interactions

T.App_Ftn: Use of Unallowed Application Functions (SCSUG)

An attacker may exploit interactions between applications to expose sensitive TOE or user data.

Interactions may include execution of commands that are not required or allowed in the specific application being performed. Examples include use of native Token OS functions that are unnecessary or that could compromise security. Inappropriate interactions could also include passing secure information such as PINs or cryptographic data between applications, or transferring value or information into applications that have been exited.

T.Fail_Secure: Failing in a Nonsecure State (TSRD)

An attacker may cause failure of the TOE security functions, causing the TOE to enter a nonsecure state.

T.LC_Ftn: Use of Unallowed Life-Cycle Functions

An attacker may exploit interactions between life-cycle functions to expose sensitive TOE or user data.

Interactions may include execution of commands that are not required or allowed in the specific phase of operation being executed. Examples include use of test, debug, or native token OS functions that are unnecessary or that could compromise security.

T.Res_Con: Resource Contention (SCSUG)

A user or attacker may willfully, or through negligence, monopolize resources of the TOE, denying service to another user or function.

If the limited resources of the TOE are allocated to a user or attacker without the authorization of the owner of the resource, then another user or function that requires the same resource may not be able to operate normally.

3.2.1.5 Threats Regarding Cryptographic Functions

T.Crypt_Attk: Cryptographic Attack (SCSUGmod: T.Crypt_Atk, T.Reuse)

An attacker may defeat security functions through a cryptographic attack against the algorithm, through cryptanalysis on encrypted data, or through a brute-force attack.

There is no protection against inherent flaws in algorithms. However, given any algorithm, there is a list of countermeasures that the implementer should follow.

3.2.1.6 Threats that Monitor Information

T.Hacker_Comm_Eavesdrop: Hacker Eavesdrops on User Data Communications (TSRD & SCSUG: T.Reuse)

Hacker obtains user data by eavesdropping on communications lines.

This threat is relevant when the system must exchange user data with a remote system, and the confidentiality of that data is important.

T.I_Leak: Information Leak (SCSUG)

An attacker may exploit information that is leaked from the TOE during normal usage.

Leakage may occur through emanations, variations in power consumption, I/O characteristics, clock frequency, or by changes in processing time requirements. This may be interpreted as a covert channel transmission but is more closely related to measurement of operating parameters. These may be derived either from direct (contact) measurements or measurement of emanations and can then be related to the specific operation being performed. An attacker may use differential power analysis or make electrical observations to exploit leaked information from the TOE.

Passive analysis security attacks on tokens may be timing attacks or waveform attacks. Analysis techniques such as Simple Power Analysis (SPA), Differential Fault Analysis (DFA), and Differential Power Analysis (DPA) may be used to perform security attacks. Recent attack developments include voltage manipulation, glitching, and combination attacks. Although external attacks are under constant development and improvement, token vendors are also making rapid progress in combating these attacks.

DPA can be used to break implementations of some symmetric or asymmetric algorithms. This technique is being used to reverse-engineer unknown algorithms and protocols by using DPA data to test hypotheses about a device's computational process. DPA and SPA can use power consumption measurements to extract secret keys from tamper-resistant devices. [4]

T.Link: Linkage of Multiple Observations (SCSUG)

An attacker may observe multiple uses of resources or services and, by linking these observations, deduce information that would reveal critical security information.

The combination of observations over a period of many uses of the TOE or the integration of knowledge gained from observing different operations may reveal information that allows an attacker to either learn information directly or to formulate an attack that could further reveal information that the TOE is required to keep secret.

3.2.1.7 Miscellaneous Threats

T.Clon: Cloning (SCSUG)

An attacker may clone part or all of a functional TOE to develop further attacks.

The information necessary to successfully clone part or all of the IC may be derived from detailed inspection of the IC itself or from illicit appropriation of design information.

Counterfeit smart cards can be mass produced using a thermal dye printer, an embosser, and an encoder.

T.Env_Strs: Environmental Stress (SCSUG)

An attacker may exploit failures in the TOE induced by environmental stress.

Exposure of the integrated circuit to conditions outside its specified operating range may result in malfunction or failure of security-critical components, allowing manipulation of programs or data. These conditions could either be extremes (high or low) in normal parameters such as temperature, voltage, or clock frequency, or could be the introduction of abnormal conditions such as external energy fields. The goal may be to generate an immediate failure, leading to unauthorized exposure of secure information, or to stimulate premature aging, thereby generating an end-of-life failure.

T.Lnk_Att: Linked Attacks (SCSUG)

An attacker may perform successive attacks with the result that the TOE becomes unstable or some aspect of the security functionality is degraded. A following attack may then be successfully executed.

Monitoring outputs while manipulating inputs in the presence of environmental stress is an example of a linked attack.

T.Rep_Atk: Repetitive Attack (SCSUG)

An attacker may utilize repetitive, undetected attempts at penetration to expose memory contents or to change security-critical elements in the TOE.

Repetitive attempts related to some or all of the other threats discussed herein may be used to iteratively develop an effective penetration of the TOE security. Monitoring outputs while manipulating inputs in the presence of environmental stress is also an example of repetitive penetration.

3.2.2 Threats Addressed by the Operating Environment

T.Hacker_Social_Engineer: Social Engineering (TSRD)

A hacker uses social engineering techniques to gain information about system entry, use, design, or operation.

This threat always exploits non-IT vulnerabilities, possibly in conjunction with IT vulnerabilities.

T.Privilege: Abuse by Privileged Users (SCSUGmod)

A careless, willfully negligent, or hostile administrator or other privileged user may create a compromise of the TOE assets through execution of actions that expose, change, or destroy the security functions or the protected/security-critical data.

A privileged user or administrator could directly implement or facilitate attacks based on any of the threats described here. TOE assets are defined as information or resources to be protected by countermeasures of the TOE (e.g., user data and cryptographic keys).

3.3 Organizational Security Policies

The organizational security policy discussed below is addressed by DoD PKI Token compliant TOEs. The policy is stated in bold type font. It is followed by an application note, in normal font, that supplies additional information and interpretation.

P.Protection_Mechanisms: Application of Protection Mechanisms

DoD Information Assurance Guidance and Policy Memorandum 6-8510. Protection mechanisms shall be applied such that the TOE maintains the appropriate level of confidentiality, integrity, authentication, and nonrepudiation based on mission criticality, sensitivity of information handled by the system, and need to know.

Each authorized role has certain specified privileges that allow access only to selected portions of the TOE and its contained information. Access beyond those specified privileges could result in exposure of security-related information.

P.Key_Length: Cryptographic Key Length

X.509 Certificate Policy for the U. S. Department of Defense. Digital Signature Standard keys shall use at least 160 bit private key and at least 1024 bit prime modulus. Minimum public key size shall be 1024 bits for Key Exchange Algorithm (KEA). Minimum public key size shall be 2048 bits for RSA. For Class 4, Elliptic Curve Digital Signature Algorithm key prime field (//p//) shall be not less than 384 bits.

4 Security Objectives

4.1 Security Objectives for the TOE

This section defines the security objectives of the TOE. These security objectives reflect the stated intent to counter identified threats and/or comply with any organizational security policies identified. Each objective is stated in bold type font. Most objectives are followed by an application note, in normal font, that supplies additional information and interpretation.

O.Auth_Protect: Protection of Authentication Data

Authentication data maintained by the TOE will be protected from disclosure and modification.

Authentication data are used to verify the claimed identity of the user. Normally, the protection will be provided by encrypting the authentication data.

O.Authenticate: Authentication of Users and SSO

Before cryptographic or other DoD data[1] are accessed, either the user's identity or an administrative role will be authenticated by the TOE.

O.Crypt: Cryptography

The TOE must perform cryptographic functions with sufficient strength for Sensitive But Unclassified (SBU) data.

The TOE must perform any cryptographic operations consistent with established cryptographic usage polices and standards for SBU data.

O.DAC: Data Access Control

The TOE must provide each authorized user with the means of controlling and limiting access to the objects and resources it owns or for which it is responsible, on

[1] DoD data are all data on the TOE located below the DoD directory. These data are owned by the DoD. It includes DoD executables, PINs, cryptographic keys, and user personal information.

the basis of user identity or role and in accordance with the P.Protection_Mechanisms Security Policy.

The TOE may have a variety of users (DoD and Non-DoD), administrators, card issuers, associations, etc., each requiring some control over the assets being handled. Some rules will apply in all cases. These are represented in security functional requirement FDP_ACF.1. The remainder must be explicitly stated as required by the needs of the owners of the data.

O.D_Read: Data Read Format

The TOE shall format data passing between modules on the IC such that information (user and TSF data) is not exposed.

The TOE must act in a fashion that does not expose information being transferred between processing and storage modules inside the IC to any greater risk of compromise than that derived from long-term storage. Bus scrambling is a technique that reduces the risk of exposing information passing between modules.

O.Data_Exchange_Conf: Enforce data exchange confidentiality

Protect user data confidentiality when exchanging data with a host.

This objective can support several types of data exchange policies, including those that do not allow communications between the local system and specific remote sites, as well as those that constrain the types of information that can be sent over communications lines.

O.Env_Strs: Environmental Stress

The TOE must protect itself against compromise by having a structure that neither reveals security information nor operates in an insecure fashion when exposed to out-of-standard conditions (high or low) in the environment, including such factors as temperature, voltage, clock frequency, and external energy fields.

The basic TOE must be designed and fabricated so that it continues to provide security to its critical information, including user assets and internal security information, even when exposed to environmental stress. Environmental stress may be a result of the normal environment in which the TOE is used, but it may also be representative of an attack against it. In the event of attack, stress may be the only driving force or it may be used in conjunction with one or several other attacks. This objective should work to prevent disclosure of security-related information.

O.Fail_Secure: Preservation of secure state for failures in critical components

Preserve the secure state of the system in the event of a secure component failure.

This objective is relevant if the TOE needs to continue some form of operation in the presence of failures. The scope of the identified failures for which the system will fail secure will, in general, directly impact the feasibility and cost of implementing this protection feature.

O.I_Leak: Information Leak

The TOE must provide the means of controlling and limiting the leakage of information in the TOE so that no useful information is unintentionally revealed over the power, ground, clock, reset, or I/O lines.

The TOE must be designed and programmed so that analysis of such elements as power consumption does not reveal information about processing operations or compromise secure information.

O.Init: Initialization

An initialized TOE not in the totally locked state must assume the nonauthenticated state immediately upon power-up, reset, or after other restart conditions.

The TOE must always start in a defined and controlled state regardless of how it was reset. This objective works to prevent attacks that attempt to upset the operation and leave the TOE in an undefined state.

O.Input_Probe: Probing by Selected Inputs

The TOE must be resistant to repeated probing through insertion of erroneous data.

If possible, the TOE must prevent the release of information though the analysis of responses to repetitive probing. This objective could also work through the detection of such attacks and the initiation of corrective actions to counter such attempts.

O.Key_Encrypt: Encryption of Stored Keys

Keys stored in nonvolatile memory on the TOE must be encrypted.

O.Life_Cycle: Life-Cycle Functions

The TOE must provide means of controlling and limiting the use of life-cycle-specific commands to the life-cycle stages in which they are intended.

The design and implementation of the TOE must be such that the only commands available to a specific operation are related to the TOE life cycle appropriate to that application. Thus, elements such as debug or one-time loading of identification registers should never be available during operational TOE use.

O.Log_Prot: Logical Protection

The TOE must protect itself against logical compromise by having a structure that is resistant to logical manipulation or modification.

The TOE must be designed and programmed so that it resists attempts to compromise its security features through attacks on its logical operation. The TOE must prevent the release of security-related information while it is operating properly in the presence of logic probes and command modifications.

Updated versions of the TOE should counter vulnerabilities discovered in previous TOE versions.

O.Mult_App: Multiple Applications

The TOE must support an application (or applications) while providing and maintaining security between and among the various resident elements.

The design and implementation of the TOE must be such that each application or major operational unit cannot affect the secure operation of other such applications. This separation must be maintained such that information that is restricted to a single application is not accessible elsewhere, nor can it be changed except from within that application.

O.Phys_Prot: Physical Protection

The TOE must be resistant to physical attack or be able to create difficulties in understanding the information derived from such an attack.

Techniques used to achieve physical protection for the TOE include: protective layering, special rules regarding IC layout, removal of test pads after completion of initial (wafer) testing, custom-made cell families, hidden logic functionality, bus scrambling, serpentine patterns, coatings, and active and passive tamper techniques.

O.Res_Access: Resource Access

The TOE shall protect its resources against monopolization by a user or attacker to the detriment of other users of the TOE.

The TOE should be designed and implemented so that resource allocation is controlled in a manner that supports all intended users.

O.SSO_Data: Data Initialized by SSO

Only the SSO may set authentication, initial security, and personalization data.

O.Secure_Host_Comms: Secure Host Communications

The TOE and the host shall establish a secure channel, using a session key composed of components created by the TOE and the host, before exchanging cryptographic or other DoD data.

O.Self_Test: Self-Test

Self-tests shall ensure the TOE is functioning properly. Integrity of all code on the TOE shall be checked. Cryptographic and other security-critical functions shall be tested. These tests shall be performed during power-up and under certain conditions.

O.Set_Up: Set up Sequence

The TOE shall require that the SSO updates the preset SSO verification data prior to entering the Nonauthenticated state or an authenticated state.

The TOE must be placed into operation in a controlled and defined manner. This acts to prevent use of the TOE before all of the protective measures may be enabled or protective codes entered.

O.Tamper_Response: Respond to Tamper

The TOE shall respond to physical tampering against specified system devices and components.

O.Tamper_Response provides capabilities to automatically respond to physical attacks against specified parts of the TOE, thereby resisting such attacks. The automatic response may take various forms but generally involves direct actions (e.g., shutting a system down) rather than notification actions.

O.Trial: Trial-and-Error Resistance

The TOE authentication mechanism is resistant to spoofing by trial and error.

Authentication data must be random from a sample size of at least 1 million. Furthermore, no more than eight authentication attempts are allowed.

O.Unlink: Linkage

The TOE must provide the means of allowing an entity to make multiple uses of resources or services without other entities being able to link those uses together.

The TOE should be designed and implemented so that no information is exposed in any normal operation that would contribute to a breach in security in another operation. This objective should work to prevent such disclosure.

O.Volatile_Memory: Destruction of Volatile Memory

The contents of volatile memory cannot be retrieved after power is removed from the TOE or a failure occurs.

4.2 Security Objectives for the Environment

These environmental objectives are partially met by assurance requirements. They levy additional requirements on the environment that are outside the scope of this PP.

OE.Con_Cont: Code Configuration Control

The TOE will be labeled with a unique instance identifier that establishes its composition, and controls will be provided to ensure that the components have not been modified.

OE.Con_Des: Control of Design

Those responsible for the TOE must ensure that design information, details of hardware security mechanisms, IC specifications, IC databases, schematics/layouts, software specifications, detailed designs, source code, or any other information are accessible only by authorized personnel.

Information that could lead to a compromise in security during TOE operation is routinely available during the design and manufacture of the TOE. This information must be protected to prevent its availability to hostile parties.

OE.Con_Prod: Control of Product

The manufacturing process shall ensure the protection of the TOE from any kind of unauthorized use such as tampering or theft.

During various stages of manufacture and preparation for use, the TOE may exist in a variety of incomplete through finished forms. These instantiations of the TOE must be protected to prevent their becoming available to hostile parties.

OE.Con_Tools: Control of Tools

The TOE development process shall ensure the protection of the development tools from any kind of unauthorized use such as tampering or theft.

A variety of tools are routinely used during the development and test of the TOE. These tools could provide significant information to a hostile party regarding the functionality of the TOE security systems and, thus, must be protected to prevent them from becoming available to hostile parties.

OE.Dlv_Aud: Delivery Audit

Procedures shall ensure that all nonconformance to mandated delivery processes are detected and that corrective actions are taken in case of improper operations.

OE.Dlv_Proc: Delivery Procedures

Procedures such as validation of code signatures shall ensure protection of TOE material/ information during delivery.

Numerous IC manufacturers, chip embedders, smart card personalizers, issuers, and others may have access to the TOE and its various support information prior to issuance. This information may be particularly vulnerable during transport between the various representatives. This objective should prevent this information from becoming available to hostile parties. Prevention includes checking the verification of signed code that is downloaded prior to execution. A well-known example is checking digital signatures on signed Java applets (see Application Specification in Appendix F).

OE.Dlv_Trn: Delivery Training

Procedures shall ensure that people dealing with the procedures for delivery (shipping department, carriers, reception department) have the required skill, training, and knowledge to meet the procedure requirements and to act fully in accordance with the above expectations.

Numerous IC manufacturers, chip embedders, smart card personalizers, issuers, and others may have access to the TOE and its various support information prior to issuance. This information may be particularly vulnerable during transport between the various representatives. This objective should prevent this information from becoming available to hostile parties.

OE.Ident: TOE Identification

Procedures must support the recording and preservation of TOE identification information on the TOE prior to being issued to the user.

The TOE consists of hardware and software elements. The software may be stored in a hard mask (through incorporation in the ROM photomask) or in nonvolatile memory. The hardware could have optional features that might or might not be enabled. It is therefore essential that an accurate identification be established for the exact instantiation of the final product compliant to this protection profile.

OE.Key_Gen: Key Generation

Key exchange keys are generated in a secure manner in accordance with X.509 Certificate Policy.

OE.Mask_Prot: Photomask Protection

The photomask fabrication management process shall ensure the protection of the mask from any kind of unauthorized use such as tampering or theft.

The photomask represents the instantiation of the hardware elements of the TOE and may contain ROM code. Information about secure functions and mask-programmed software and codes are included in the TOE photomasks. Furthermore, availability of the photomasks could significantly reduce the effort required to clone all or part of the TOE. The photomasks must therefore be protected to prevent them from becoming available to hostile parties.

OE.Personnel: Personnel

Personnel working as administrators or in other privileged positions shall be carefully selected and trained for reliability.

OE.Role_Man: Role Management

Management of roles for the TOE is performed in a secure manner off-TOE.

Table 4-1 Required Roles

Role	Role Description
SSO	System Security Officer
Default SSO	SSO that has initial access to noninitialized TOE
Super SSO	An entity who can unlock the TOE following SSO authentication failures
DoD User	User of the TOE who is allowed access to DoD data
Non-DoD User	User of the TOE who is not allowed access to DoD data

OE.SW_Develop: Software Development Process

All code to be used for the TOE will be developed using a software development process that is standard and consistent across the organization.

OE.Sample_Acs: Sample Access

Samples used to run tests shall be accessible only by authorized personnel.

The preparation of samples, sometimes in large quantities, is routine during the development of a fully operational TOE. These samples represent the TOE in a variety of incomplete through finished forms. These instantiations must be protected to prevent them from becoming available to hostile parties.

OE.Sec_Com: Secure Communication

Only a trusted host[2] can establish a secure connection with the TOE.

The secure connection implies that the TOE is in a DoD authenticated state and that the host can be trusted.

OE.Train: User Training

Users will be trained on the usage policy of the TOE in accordance with proper security procedures.

2 Device to which a token authenticates to establish a secure communication path.

5 IT Security Requirements

5.1 TOE Security Functional Requirements

This section contains the security functional requirements that must be satisfied by a TOE compliant with the DoD PKI Token PP. Security Function Policies used by the security functional requirements are listed in section 5.1.1. Components, which group related security functional requirements, are listed in Table 5-2. The security functional requirements are listed in sections 5.1.3–5.1.10.

5.1.1 Security Function Policies

Several of the functional requirements in section 5.1 reference Security Function Policies (SFPs). SFPs are named pieces of requirements. They are not organizational policies.
The SFPs used by the functional requirements in this PP are listed below:

P.Application: Application Use Security Function Policy

An application can only be used by the TOE after its signature by a DoD entity is validated. A DoD-defined state prescribes those DoD applications that may execute on the TOE. The Application Specification further details the use of applications by the TOE (see Appendix F).

A DoD state determines which applications can execute when the TOE is in that state. Appendix D, section 4, defines the DoD states.

P.DAC: Data Access Control Security Function Policy

Table 5-1 defines access privileges by role and information type. The Data Access Control Security Policy (P.DAC) is used in the access control, export, and import of data, and management of security attributes requirements.

The SSO role can only be assumed after successful authentication to the TOE as specified in the SSO Authentication Scheme Specification (see Appendix F).

Table 5-1 Access Control Table

Information Type	Role	Function[3]
User Authentication data[4]	SSO	initialize, modify
SSO Authentication data	Default SSO, SSO	update
Personalization data[5]	SSO	set, read
	User	read
DoD PKI signature, e-mail signature keys	DoD User	generate, access
Key exchange keys	DoD User	load, access
Certificate[6]	SSO, DoD User	load
	All	access
Data[7]	DoD User	encrypt,[8] decrypt, sign
DoD Directories	SSO	create, rename, read, delete
	DoD User	read, write, resize
Non-DoD Directory	SSO	create, rename, read, delete
	Non-DoD User	read, write, resize
DoD File	DoD User	as specified by application
Non-DoD File	Non-DoD User	as specified by application
Security Attributes	SSO	default, modify, delete

P.Exchange_Protection: DoD Data Exchange Protection

All DoD data transmitted between the TOE and a host will be encrypted with a session key shared between the host and the TOE.

Successfully sharing a session key implies the host is trusted.

P.Info_Flow_Control: Information Flow Control

Information only flows between subjects by way of data objects with access specified by P.DAC.

The information is represented as user and TSF data. This should rule out information flowing between subjects (e.g., applications and OS processes) through covert channels. Labels may be used for data to control the flow of information.

[3] Operations allowed for the given type of information in the given role.
[4] Information used to verify the claimed identity of the user.
[5] User name, social security number, etc.
[6] DoD PKI, e-mail, key exchange, root CA, CA, etc.
[7] E.g., e-mail.
[8] Including signing.

5.1.2 Security Functional Components

Table 5-2 summarizes the security functional components that appear in this PP.

Table 5-2 Security Functional Components

Component	Component Name
FCS_CKM.1	Cryptographic key generation
FCS_CKM.2	Cryptographic key distribution
FCS_CKM.3	Cryptographic key access
FCS_CKM.4	Cryptographic key destruction
FCS_COP.1	Cryptographic operation
FDP_ACC.1	Subset access control
FDP_ACF.1	Security attribute-based access control
FDP_DAU.1	Basic data authentication
FDP_ETC.1	Export of user data with security attributes
FDP_IFC.1	Subset information flow control
FDP_IFF.1	Simple security attributes
FDP_IFF.3	Limited illicit information flows
FDP_ITC.1	Import of user data with security attributes
FDP_ITT.1	Basic internal transfer protection
FDP_RIP.1	Subset residual information protection
FDP_UIT.1	Data exchange integrity
FIA_AFL.1	Authentication failure handling
FIA_ATD.1	User attribute definition
FIA_SOS.1	Verification of secrets
FIA_UAU.1	Timing of authentication
FIA_UAU.6	Re-authenticating
FIA_UAU.7	Protected authentication feedback
FIA_UID.2	User identification before any action
FMT_MOF.1	Management of security functions behavior
FMT_MSA.1	Management of security attributes
FMT_MSA.2	Secure security attributes
FMT_MSA.3	Static attribute initialization
FMT_MTD.1	Management of TSF data
FMT_MTD.2	Management of limits of TSF data
FMT_MTD.3	Secure TSF data
FMT_REV.1	Revocation
FMT_SMR.1	Security roles
FMT_SMR.3	Assuming roles
FPT_AMT.1	Abstract machine testing
FPT_FLS.1	Failure with preservation of secure state
FPT_ITI.1	Inter-TSF detection of modification
FPT_ITT.1	Basic internal TSF data transfer protection
FPT_PHP.1	Passive detection of physical attack

Component	Component Name
FPT_PHP.3	Resistance to physical attack
FPT_RCV.4	Function recovery
FPT_RVM.1	Non-bypassability of the TSP
FPT_SEP.1	TSF domain separation
FPT_TST.1	TSF testing
FRU_RSA.1	Maximum quotas
FTP_ITC.1	Inter-TSF trusted channel

5.1.3 Cryptographic support (FCS) requirements

5.1.3.1 Cryptographic key generation (FCS_CKM.1)

FCS_CKM.1.1
The TSF shall generate cryptographic keys in accordance with a specified cryptographic key generation algorithm from list of approved cryptographic algorithms in Appendix E and specified cryptographic key sizes of

- at least 160 bit private key with at least 1024 bit prime modulus for Digital Signature Standard keys;
- at least 1024 bit public key for Key Exchange Algorithm (KEA);
- at least 2048 bit public key for RSA;
- at least 384 bit for Elliptic Curve Digital Signature Algorithm key prime field (//p//);

that meet the following: FIPS 140-2 Level 2 for Subscribers/Level 3 for Registration Authorities and Certificate Authorities and X.509 Certificate Policy.

Refinement: The Key Management and SSO Authentication Specification (see Appendix F) levies additional key generation requirements.

Application notes:
- Throughout the requirements in this PP, references are made to requirements for FIPS 140-2 Level 2 for Subscribers/Level 3 for Registration Authorities and Certificate Authorities. If the DoD Common Access Card issuing infrastructure is not capable of issuing two different levels of cards, then all CACs will be required to meet FIPS 140-2 Level 3.
- Keys for channel sessions must be composed of components created by the TOE and the host.
- The asymmetric key generation process must create its own prime numbers (i.e., it must not rely on replaced values).
- A hardware randomization source is required.

5.1.3.2 Cryptographic key distribution (FCS_CKM.2)

FCS_CKM.2.1
The TSF shall distribute cryptographic keys in accordance with a specified cryptographic key distribution method encryption with key exchange keys for symmetric keys in a DoD

Authenticated State that meets the following: FIPS 140-2 Level 2 for Subscribers/Level 3 for Registration Authorities andCertificate Authorities.

Refinement: The Key Management and SSO Authentication Specification (see Appendix F) levies additional key distribution requirements.

Application note: Possession of the Key Exchange Key authenticates the host to the TOE.

5.1.3.3 Cryptographic key access (FCS_CKM.3)

FCS_CKM.3.1
The TSF shall perform encryption of cryptographic keys in nonvolatile memory in accordance with a specified cryptographic key access method, cryptographic key storage, that meets the following: FIPS 140-2 Level 2 for Subscribers/Level 3 for Registration Authorities and Certificate Authorities.

Refinement: The Key Management and SSO Authentication Specification (see Appendix F) levies additional key access and storage requirements.

Application note: Cryptographic keys should be encrypted with Key Storage Keys while in nonvolatile memory. See the Key Management and SSO Authentication Specification (Appendix F) for additional information.

5.1.3.4 Cryptographic key destruction (FCS_CKM.4)

FCS_CKM.4.1
The TSF shall destroy cryptographic keys in accordance with a specified cryptographic key destruction method, zeroization, that meets the following: FIPS 140-2 Level 2 for Subscribers/Level 3 for Registration Authorities and Certificate Authorities.
Refinement: The Key Management and SSO Authentication Specification (see Appendix F) levies additional key destruction requirements.

Application note: Zeroization shall destroy unencrypted private keys by altering or deleting memory (i.e., RAM) containing such keys. Tamper detection and loss of power to the TOE should result in the erasure of unencrypted private keys on the TOE. After destroying all key-related information, the token will enter the Totally Locked State.

5.1.3.5 Cryptographic operation (FCS_COP.1)

FCS_COP.1.1
The TSF shall perform signing e-mail hash values and wrapping or unwrapping e-mail session keys in accordance with a specified cryptographic algorithm from a list of approved cryptographic algorithms in Appendix E and cryptographic key sizes of

- at least 160 bit private key with at least 1024 bit prime modulus for Digital Signature Standard keys;
- at least 1024 bit public key for Key Exchange Algorithm (KEA);
- at least 2048 bit public key for RSA;
- at least 384 bit for Elliptic Curve Digital Signature Algorithm key prime field (//p//);

that meet the following: FIPS 140-2 Level 2 for Subscribers/Level 3 for Registration Authorities and Certificate Authorities and X.509 Certificate Policy.

Refinement: The Key Management and SSO Authentication Specification (see Appendix F) levies additional cryptographic operation requirements.

5.1.4 User data protection (FDP) requirements

5.1.4.1 Subset access control (FDP_ACC.1)

FDP_ACC.1.1
The TSF shall enforce the P.DAC and Application Use Security Function Policy (P.Application) on:
Subjects: Default SSO, SSO, Super SSO, DoD users, non-DoD users;
Objects: Authentication data, personalization data, and initial security data,

- objects in DoD directory: root certificate, user certificate, user private key, directories, applications;
- objects in non-DoD directory: root certificate, user certificate, user private key, directories, applications; and

operations among subjects and objects covered by the SFP.

5.1.4.2 Security attribute based access control (FDP_ACF.1)

FDP_ACF.1.1
The TSF shall enforce the Data Access Control Security Function Policy (P.DAC) and Application Use Security Function Policy (P.Application) to objects based on role including those in Table 4-1, [ST assignment: security attributes, named groups of security attributes].

FDP_ACF.1.2
The TSF shall enforce the following rules to determine if an operation among controlled subjects and controlled objects is allowed:
(a) Roles: as defined in P.DAC
(b) File Control: The process and commands for creating the application file structure, including file access, shall be defined in the ST in accordance with P.DAC.
(c) Crypt: The platform must be capable of securely storing PINs and other secret data, including cryptographic data, using access control provisions which ensure that such data cannot be read from outside.

d) First-Use: Initial authentication should be performed on first use (as specified in the ST). Indication of first use shall not be alterable.

FDP_ACF.1.3
The TSF shall explicitly authorize access of subjects to objects based on the following additional rules:
(a) The TOE must maintain a list of allowed roles or individuals per directory and file.
(b) The list must contain (at a minimum) a cross-reference of access privileges (e.g., read, write, execute, etc.) to be associated with each role, the authentication method and data used for authentication required for each role.
(c) The TOE must maintain single-bit integrity of its access information. The data integrity of the access control information and file must be verified before granting access to the directory or file.

FDP_ACF.1.4
The TSF shall explicitly deny access of subjects to objects based on the following:
(a) The TOE must maintain a list of allowed roles or individuals per directory and file.
(b) The list must contain (at a minimum) a cross-reference of access privileges (e.g., read, write, execute, etc.) to be associated with each role, the authentication method and data used for authentication required for each role.
(c) The list must be protected by the TOE's data integrity mechanism. The data integrity of the file (and list) must be verified before granting access to the directory or file.

5.1.4.3 Basic data authentication (FDP_DAU.1)

FDP_DAU.1.1
The TSF shall provide a capability to generate evidence that can be used as a guarantee of the validity of DoD data.

FDP_DAU.1.2
The TSF shall provide the TOE with the ability to verify evidence of the validity of the indicated information.

5.1.4.4 Export of user data with security attributes (FDP_ETC.1)

FDP_ETC.1.1
The TSF shall enforce the P.DAC and the DoD Data Exchange Protection Security Function Policy (P.Exchange_Protection) when exporting user data, controlled under the SFP(s), outside of the TSC.

FDP_ETC.1.2
The TSF shall export the user data without the user data's associated security attributes.

5.1.4.5 Subset information flow control (FDP_IFC.1)

FDP_IFC.1.1
The TSF shall enforce the P.Exchange_Protection and Information Flow Control Security Function Policy (P.Info_Flow_Control) on [ST assignment: list of subjects, information, and operations that cause controlled information to flow to and from controlled subjects covered by the SFP].

5.1.4.6 Simple security attributes (FDP_IFF.1)

FDP_IFF.1.1
The TSF shall enforce the P.Info_Flow_Control based on the following types of subject and information security attributes: application.

Application note: The subject attribute *application* denotes the application being executed.

FDP_IFF.1.2
The TSF shall permit an information flow between a controlled subject and controlled information via a controlled operation if the following rules hold: as specified by the applications.

FDP_IFF.1.3
The TSF shall enforce the following: none.

FDP_IFF.1.4
The TSF shall provide the following: none.

FDP_IFF.1.5
The TSF shall explicitly authorize an information flow based on the following rules: none.

FDP_IFF.1.6
The TSF shall explicitly deny an information flow based on the following rules: none.

5.1.4.7 Limited illicit information flows (FDP_IFF.3)

FDP_IFF.3.1
The TSF shall enforce the P.Info_Flow_Control to limit the capacity of information leaked over power, ground, clock, reset, or I/O lines to a [ST assignment: maximum capacity].

5.1.4.8 Import of user data without security attributes (FDP_ITC.1)

FDP_ITC.1.1
The TSF shall enforce the P.DAC and the P.Exchange_Protection when importing user data, controlled under the SFP, from outside of the TSC.

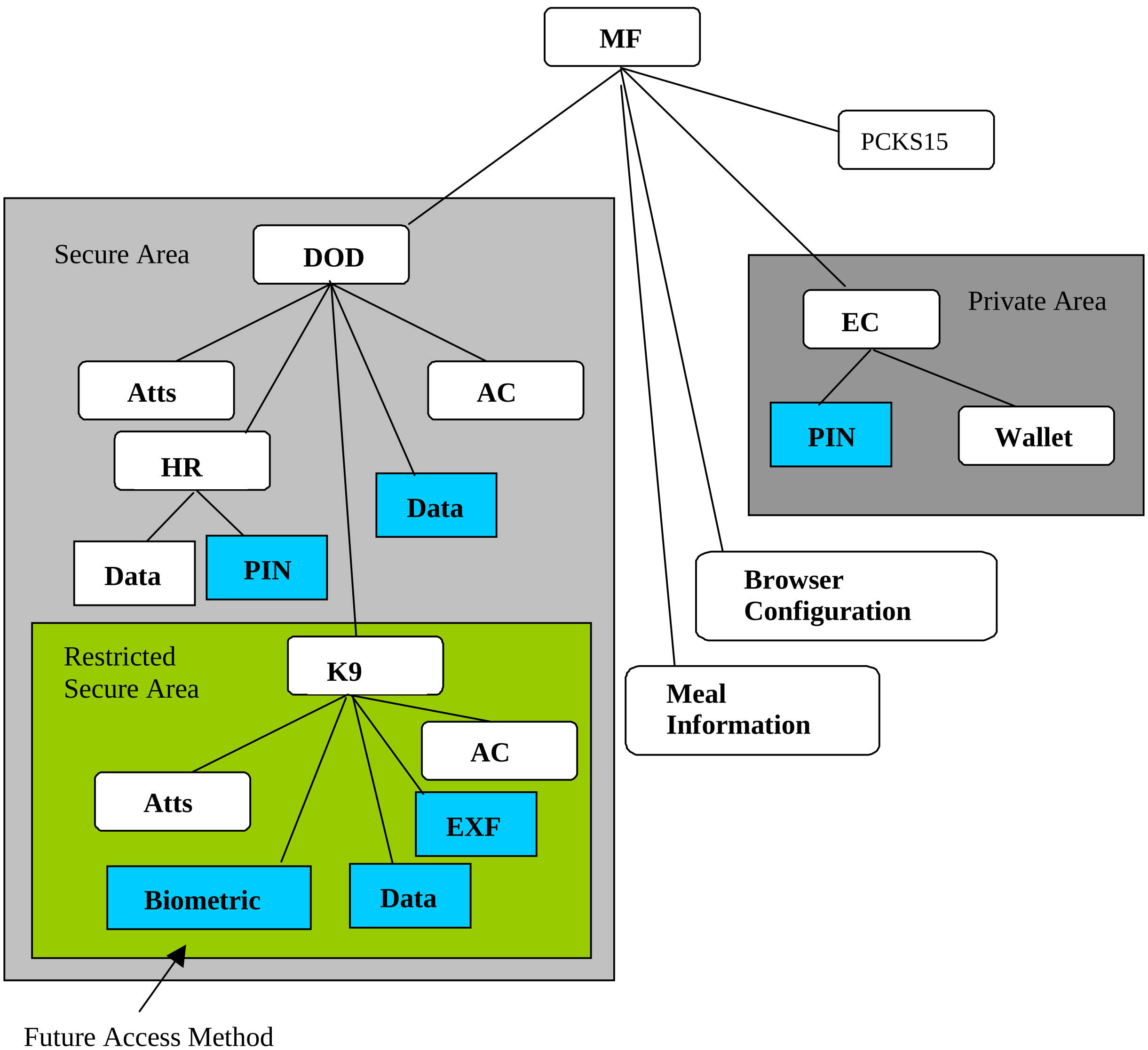
FDP_ITC.1.2
The TSF shall ignore any security attributes associated with the user data when imported from outside the TSC.

FDP_ITC.1.3
The TSF shall enforce the following rules when importing user data controlled under the SFP from outside the TSC:
(a) Data Load: The SSO controls the loading of data into the Master File (MF) (top-level directory), including the loading of non-DoD applications. Non-DoD applications have control within their directories. See Figure 1 in the application note below.
(b) Application Load: All loading of applications onto the TOE requires signature verification by the TOE as detailed in the application specification (see Appendix F).

Application note: The token must hold the public value of a key to verify the signature appended to the application. This application verification key must be held in nonvolatile memory (e.g., ROM). Refer to the Key Management and SSO Authentication Specification for details regarding the handling of application verification keys (see Appendix F).

An example of a token's directory structure is illustrated below in Figure 5-1. The directory structure shown is compliant with ISO 7816-4. Although this standard is intended for smart cards, many other types of tokens have adopted its use. The DoD directory (secure area) allocates resources for DoD objects (files). The DoD directory also controls the MF, granting resources on the token.

Figure 5-1 Directory Structure Example



5.1.4.9 Basic internal transfer protection (FDP_ITT.1)

FDP_ITT.1.1
The TSF shall enforce the <u>P.DAC and P.Info_Flow_Control</u> to prevent the <u>disclosure or modification</u> of user data when it is transmitted between physically separated parts of the TOE.

Application note: For a token, "physically separated parts of the TOE" means portions of the IC separated by bus lines or modules on the token.

5.1.4.10 Subset residual information protection (FDP_RIP.1)

FDP_RIP.1.1
The TSF shall ensure that any previous information content of a resource is made unavailable upon the <u>deallocation of the resource from</u> the following objects: <u>DoD applications</u>.

5.1.4.11 Data exchange integrity (FDP_UIT.1)

FDP_UIT.1.1
The TSF shall enforce the <u>P.Exchange_Protection</u> to be able to <u>receive and transmit</u> user data in a manner protected from <u>modification, deletion, insertion, or replay</u> errors.

FDP_UIT.1.2
The TSF shall be able to determine on receipt of user data, whether either <u>modification, deletion, insertion, or replay</u> has occurred.

Application note: Corrupted data will be discarded.

5.1.5 Identification and authentication (FIA) requirements

5.1.5.1 Authentication failure handling (FIA_AFL.1)

FIA_AFL.1.1
The TSF shall detect when <u>eight (by the user) or four (by the SSO)</u> unsuccessful authentication attempts occur related to <u>login</u>.

FIA_AFL.1.2
When the defined number of unsuccessful authentication attempts has been met or surpassed, the TSF shall <u>enter a locked state</u>.

5.1.5.2 User attribute definition (FIA_ATD.1)

FIA_ATD.1.1
The TSF shall maintain the following list of security attributes belonging to individual users: <u>role (e.g., SSO, user), and [ST assignment: list of additional security attributes]</u>.

5.1.5.3 Verification of secrets (FIA_SOS.1)

FIA_SOS.1.1
The TSF shall provide a mechanism to verify that secrets meet a biometric for the user or a password or PIN with minimum length of 6 bytes for the user and 16 bytes for the SSO and Super SSO.

Application notes:
- The SSO, Super SSO, and user authentication mechanisms specified in this requirement serve as the authentication mechanisms required for entering the token's authenticated states as defined in Appendix D.
- While the user will have a personal password or PIN, each SSO cannot have a unique password/PIN. Therefore, an SSO authentication scheme (see Appendix F) shall be used.

5.1.5.4 Timing of authentication (FIA_UAU.1)

FIA_UAU.1.1
The TSF shall allow:

- Obtaining general status information about the TOE
- Obtaining directory or file information about non-DoD directories if the application that owns the directory allows it
- Accessing non-DoD data
- [ST assignment: additional TSF-mediated actions] on behalf of the user to be performed before the user is authenticated.

FIA_UAU.1.2
The TSF shall require each user to be successfully authenticated before allowing any other TSF-mediated actions on behalf of that user.

Application note: Users and SSOs must be successfully authenticated prior to assuming any roles on the TOE.

5.1.5.5 Re-authenticating (FIA_UAU.6)

FIA_UAU.6.1
The TSF shall re-authenticate the user under the conditions during which token security may have been breached or when the user performs an action for which he or she may be held legally responsible, including

(a) periods of inactivity of at least 10 minutes
(b) use of signature keys for e-commerce applications
(c) storage of a prescription on the token by a doctor

5.1.5.6 Protected authentication feedback (FIA_UAU.7)

FIA_UAU.7.1
The TSF shall provide only nothing to the user while the authentication is in progress.

5.1.5.7 User identification before any action (FIA_UID.2)

FIA_UID.2.1
The TSF shall require each user to identify him- or herself before allowing any other TSF-mediated actions on behalf of that user.

5.1.6 Security management (FMT) requirements

5.1.6.1 Management of security functions behavior (FMT_MOF.1)

FMT_MOF.1.1
The TSF shall restrict the ability to determine, disable, enable, or modify the behavior of the functions:
(a) Changes to cryptographic key attributes including key type (e.g., public, private, secret), validity period, and use (e.g., digital signature, key encryption, key agreement, data encryption)
(b) Actions to be taken in the event of an authentication failure
(c) Actions that can be taken before the user is authenticated
(d) Rules for authentication
(e) Revocation rules
(f) List of actions that need to be taken in case of repetitive penetration attempts
(g) Conditions under which TSF self-testing occurs, such as during initial start-up, regular interval, or under specified conditions to the SSO role.

5.1.6.2 Management of security attributes (FMT_MSA.1)

FMT_MSA.1.1
The TSF shall enforce the P.DAC to restrict the ability to change_default, modify, or delete the security attributes roles, object owner, and the application to which an object belongs to the SSO.

5.1.6.3 Secure security attributes (FMT_MSA.2)

FMT_MSA.2.1
The TSF shall ensure that only secure values are accepted for security attributes.

5.1.6.4 Static attribute initialization (FMT_MSA.3)

FMT_MSA.3.1
The TSF shall enforce the P.DAC and P.Info_Flow_Control SFPs to provide restrictive default values for security attributes that are used to enforce the SFP.

FMT_MSA.3.2
The TSF shall allow the SSO to specify alternative initial values to override the default values when an object or information is created.

5.1.6.5 Management of TSF data (FMT_MTD.1)

FMT_MTD.1.1
The TSF shall restrict the ability to change default, query, modify, delete, clear, and [ST assignment: other operations] the SSO authentication data, and [ST assignment: list of additional TSF data] to SSO.

5.1.6.6 Management of limits on TSF data (FMT_MTD.2)

FMT_MTD.2.1
The TSF shall restrict the specification of the limits for [ST assignment: *list of TSF data*] to the SSO.

FMT_MTD.2.2
The TSF shall take the following actions, if the TSF data are at, or exceed, the indicated limits: enter the DoD Locked State.

5.1.6.7 Secure TSF data (FMT_MTD.3)

FMT_MTD.3.1
The TSF shall ensure that only secure values are accepted for TSF data.

5.1.6.8 Revocation (FMT_REV.1)

FMT_REV.1.1
The TSF shall restrict the ability to revoke security attributes associated with the users, subjects, objects, and other additional resources within the TSC to SSO.

FMT_REV.1.2
The TSF shall enforce the rules upon exit from the DoD SSO Authenticated State.

5.1.6.9 Security roles (FMT_SMR.1)

FMT_SMR.1.1
The TSF shall maintain the roles specified in Table 4-1.

FMT_SMR.1.2
The TSF shall be able to associate users with roles.

5.1.6.10 Assuming roles (FMT_SMR.3)

FMT_SMR.3.1
The TSF shall require an explicit request to assume the following roles: SSO

5.1.7 Protection of the TOE Security Functions (FPT) requirements

5.1.7.1 Abstract machine testing (FPT_AMT.1)

FPT_AMT.1.1
The TSF shall run a suite of tests in accordance with FIPS 140-2 Level 2 for Subscribers/Level 3 for Registration Authorities and Certificate Authorities during initial start-up, when conditions are outside the normal range, or when requested by the user to demonstrate the correct operation of the security assumptions provided by the abstract machine that underlies the TSF.

5.1.7.2 Failure with preservation of secure state (FPT_FLS.1)

FPT_FLS.1.1
The TSF shall preserve a secure state when the following types of failures occur: power supplied outside of normal operating range, physical tampering, faulty clock signal, or temperature outside normal operating range.

Application note: Following a power, clock or temperature failure, the TOE must enter the Power-On State. Following the detection of tampering, the TOE must enter the Totally Locked State. In these states, the TOE's volatile memory shall not contain valid information.

5.1.7.3 Inter-TSF detection of modification (FPT_ITI.1)

FPT_ITI.1.1
The TSF shall provide the capability to detect modification of all TSF data during transmission between the TSF and a remote trusted IT product within the following metric: <u>cryptographic checksum</u>.

FPT_ITI.1.2
The TSF shall provide the capability to verify the integrity of all TSF data transmitted between the TSF and a remote trusted IT product and perform <u>an ignore of the TSF data and request that the originating trusted product to send the TSF data again</u> if modifications are detected.

5.1.7.4 Basic internal TSF data transfer protection (FPT_ITT.1)

FPT_ITT.1.1
The TSF shall protect TSF data from <u>disclosure</u> when it is transmitted between separate parts of the TOE.

5.1.7.5 Passive detection of physical attack (FPT_PHP.1)

FPT_PHP.1.1
The TSF shall provide unambiguous detection of physical tampering that might compromise the TSF.

Refinement: physical protection measures in accordance with FIPS 140-2 Level 2 for Subscribers/Level 3 for Registration Authorities and Certificate Authorities must be taken to meet this requirement.

Application note: The term "unambiguous" means detectable by the user. Physical tampering must be evident by inspection by the average user of the token.

FPT_PHP.1.2
The TSF shall provide the capability to determine whether physical tampering with the TSF's devices or TSF's elements has occurred.

Application note: Detection of tampering shall place the TOE in the Totally Locked State.

5.1.7.6 Resistance to physical attack (FPT_PHP.3)

FPT_PHP.3.1
The TSF shall resist physical probing and manipulation, exposure to temperatures outside the normal operating range, faulty clock signals, and exposure to supplied power outside the operating range to the authentication information, private key(s), random number generator, cryptographic circuits, memory, and [ST assignment: other devices/elements] by responding automatically such that the TSP is not violated.

Application note: In cases of out-of-range temperatures and power and faulty clock signals, the TOE will automatically enter the Power-On state to prevent violation of the TSP. In cases of the detection of physical probing and manipulation, the TOE will automatically enter the Totally Locked state to prevent violation of the TSP.

5.1.7.7 Function recovery (FPT_RCV.4)

FPT_RCV.4
The TSF shall ensure that power supplied outside of normal operating range, physical tampering, faulty clock signal, temperature outside normal operating range, and [ST assignment: other failures] have the property that the SF either completes successfully, or for the indicated failure scenarios, recovers to a consistent and secure state.

Application note: In cases of out-of-range temperatures and power and faulty clock signals, the TOE will automatically enter the Power-On State, requiring user authentication before any more actions. In cases of the detection of physical probing and manipulation, the TOE will automatically enter the Totally Locked state.

5.1.7.8 Non-bypassability of the TSP (FPT_RVM.1)

FPT_RVM.1.1
The TSF shall ensure that TSP enforcement functions are invoked and succeed before each function within the TSC is allowed to proceed.

5.1.7.9 TSF domain separation (FPT_SEP.1)

FPT_SEP.1.1
The TSF shall maintain a security domain for its own execution that protects it from interference and tampering by untrusted subjects.

FPT_SEP.1.2
The TSF shall enforce separation between the security domains of subjects in the TSC.

5.1.7.10 TSF testing (FPT_TST.1)

FPT_TST.1.1
The TSF shall run a suite of self tests during initial start-up and when power, input frequency, or temperature are outside of their normal operating conditions to demonstrate the correct operation of the TSF.

FPT_TST.1.2
The TSF shall provide authorized users with the capability to verify the integrity of TSF data.

FPT_TST.1.3
The TSF shall provide authorized users with the capability to verify the integrity of stored TSF executable code.

5.1.8 Resource utilization (FRU) requirements

5.1.8.1 Maximum quotas (FRU_RSA.1)

FRU_RSA.1.1
The TSF shall enforce maximum quotas of the following resources: memory, program space, [ST assignment: controlled resources] that users, SSOs, and executables can use simultaneously and over a specified period of time.

5.1.9 Trusted path/channels (FTP) requirements

5.1.9.1 Inter-TSF trusted channel (FTP_ITC.1)

FTP_ITC.1.1
The TSF shall provide a communication channel between itself and a remote trusted IT product that is logically distinct from other communication channels and provides assured identification of its end points and protection of the communicated channel data from modification or disclosure.

FTP_ITC.1.2
The TSF shall permit the TSF and/or the trusted host to initiate communication via the trusted channel.

FTP_ITC.1.3
The TSF shall initiate communication via the trusted channel for initial user authentication, cryptographic and DoD data exchange, loading applications, and [ST assignment: other services for which trusted channel is required].

5.2 TOE Security Assurance Requirements

The requirements in this section support specific objectives or are included to be consistent with an Evaluation Assurance Level (EAL) of 4. The TOE has an EAL4 augmented assurance level, which means that the addition of assurance components or the substitution of higher assurance components has been made to the group of EAL4 assurance requirements. The TOE Security Requirements have been augmented with AVA_VLA.3 (substitution for AVA_VLA.2) and ADV_CMM.1 (an additional assurance requirement).

Four of the assurance requirements have been refined. These refined assurance requirements are as follows:

ADO_DEL.2
ADV_IMP.1
ALC_DVS.1
AVA_VLA.3

Table 5-3 Assurance Requirements: EAL(4) Augmented

Assurance Class	Assurance Components
ACM	ACM_AUT.1, ACM_CAP.4, ACM_SCP.2
ADO	ADO_DEL.2, ADO_IGS.1
ADV	ADV_FSP.2, ADV_HLD.2, ADV_IMP.1, ADV_LLD.1, ADV_RCR.1, ADV_SPM.1, **ADV_CMM.1**
AGD	AGD_ADM.1, AGD_USR.1
ALC	ALC_DVS.1, ALC_LCD.1, ALC_TAT.1
ATE	ATE_COV.2, ATE_DPT.1, ATE_FUN.1, ATE_IND.2
AVA	AVA_MSU.2, AVA_SOF.1, **AVA_VLA.3**

5.2.1 Configuration management (ACM)

5.2.1.1 Partial CM automation (ACM_AUT.1)

Developer Action Elements:

ACM_AUT.1.1D
The developer shall use a CM system.

ACM_AUT.1.2D
The developer shall provide a CM plan.

Content and Presentation of Evidence Elements:

ACM_AUT.1.1C
The CM system shall provide an automated means by which only authorized changes are made to the TOE implementation representation.

ACM_AUT.1.2C
The CM system shall provide an automated means to support the generation of the TOE.

ACM_AUT.1.3C
The CM plan shall describe the automated tools used in the CM system.

ACM_AUT.1.4C
The CM plan shall describe how the automated tools are used in the CM system.

Evaluator Action Elements:

ACM_AUT.1.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

5.2.1.2 Generation support and acceptance procedures (ACM_CAP.4)

Developer Action Elements:

ACM_CAP.4.1D
The developer shall provide a reference for the TOE.

ACM_CAP.4.2D
The developer shall use a CM system.

ACM_CAP.4.3D
The developer shall provide CM documentation.

Content and Presentation of Evidence Elements:

ACM_CAP.4.1C
The reference for the TOE shall be unique to each version of the TOE.

ACM_CAP.4.2C
The TOE shall be labeled with its reference.

ACM_CAP.4.3C
The CM documentation shall include a configuration list, a CM plan, and an acceptance plan.

ACM_CAP.4.4C
The configuration list shall describe the configuration items that comprise the TOE.

ACM_CAP.4.5C
The CM documentation shall describe the method used to uniquely identify the configuration items.

ACM_CAP.4.6C
The CM system shall uniquely identify all configuration items.

ACM_CAP.4.7C
The CM plan shall describe how the CM system is used.

ACM_CAP.4.8C
The evidence shall demonstrate that the CM system is operating in accordance with the CM plan.

ACM_CAP.4.9C
The CM documentation shall provide evidence that all configuration items have been and are being effectively maintained under the CM system.

ACM_CAP.4.10C
The CM system shall provide measures such that only authorized changes are made to the configuration items.

ACM_CAP.4.11C
The CM system shall support the generation of the TOE.

ACM_CAP.4.12C
The acceptance plan shall describe the procedures used to accept modified or newly created configuration items as part of the TOE.

Evaluator Action Elements:

ACM_CAP.4.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

5.2.1.3 Problem tracking CM coverage (ACM_SCP.2)

Developer Action Elements:

ACM_SCP.2.1D
The developer shall provide CM documentation.

Content and Presentation of Evidence Elements:

ACM_SCP.2.1C
The CM documentation shall show that the CM system, as a minimum, tracks the following: the TOE implementation representation, design documentation, test documentation, user documentation, administrator documentation, CM documentation, and security flaws.

ACM_SCP.2.2C
The CM documentation shall describe how configuration items are tracked by the CM system.

Evaluator Action Elements:

ACM_SCP.2.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

5.2.2 Delivery and operation (ADO)

5.2.2.1 Detection of modification (ADO_DEL.2)

Developer Action Elements:

ADO_DEL.2.1D
The developer shall document procedures for delivery of the TOE or parts of it to the user.

(Refinement) The TOE, or parts of it, are refined to include at least the following:

(a) Design Information
1. IC specification and technology
2. IC design
3. IC hardware security mechanisms
4. IC software security mechanisms
5. photomask
6. development tools
7. initialization procedures
8. access control mechanisms
9. authentication systems
10. data protection systems
11. memory partitioning
12. cryptographic programs

(b) Data
1. initialization data
2. personalization data

3. passwords
4. cryptographic keys

(c) Test Information
1. test tools
2. test procedures
3. test programs
4. test results

(d) Physical Instantiations
1. silicon samples
2. bond-out chips
3. pre-initialized cards
4. pre-personalized cards
5. personalized but unissued cards

ADO_DEL.2.2D
The developer shall use the delivery procedures.

Content and Presentation of Evidence Elements:

ADO_DEL.2.1C
The delivery documentation shall describe all procedures that are necessary to maintain security when distributing versions of the TOE to a user's site.

ADO_DEL.2.2C
The delivery documentation shall describe how the various procedures and technical measures provide for the detection of modifications, or any discrepancy between the developer's master copy and the version received at the user site.

ADO_DEL.2.3C
The delivery documentation shall describe how the various procedures allow detection of attempts to masquerade as the developer, even in cases in which the developer has sent nothing to the user's site.

Evaluator Action Elements:

ADO_DEL.2.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

5.2.2.2 Installation, generation, and start-up procedures (ADO_IGS.1)

<u>Developer Action Elements</u>:

ADO_IGS.1.1D
The developer shall document procedures necessary for the secure installation, generation, and start-up of the TOE.

<u>Content and Presentation of Evidence Elements:</u>

ADO_IGS.1.1C
The documentation shall describe the steps necessary for secure installation, generation, and start-up of the TOE.

<u>Evaluator Action Elements:</u>

ADO_IGS.1.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

ADO_IGS.1.2E
The evaluator shall determine that the installation, generation, and start-up procedures result in a secure configuration.

5.2.3 Development (ADV)

5.2.3.1 Developer CMM Level 1 (ADV_CMM.1)

<u>Developer Action Elements</u>:

ADV_CMM.1.1D
The developer's software process that produces the TOE operating system, EXF, or interface software for the TOE shall be assessed against the Software Engineering Institute's (SEI) Capability Maturity Model (CMM) through a Software Capability Evaluation conducted by an SEI authorized lead assessor.

Application note: This requirement is a "placeholder" for stronger CMM requirements in future revisions of this protection profile. Over the next few years, the DoD intends to require that the software process for the developer of the DoD PKI Token meet CMM Level 3.

<u>Content and Presentation of Evidence Elements:</u>

ADV_CMM.1.1C
The developer's standard software process at CMM Level 1 for developing and maintaining TOE software shall be documented. The results of the developer's Software Capability Evaluation shall be provided. Results include the assessed CMM level, and the specific Key Processes Areas (KPAs) that were satisfied within each CMM level (whether or not all KPAs for the level were met). Additionally, the "Findings Report" that documents the current state of the developer's software development process shall be provided.

<u>Evaluator Action Elements:</u>

ADV_CMM.1.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

5.2.3.2 Fully defined external interfaces (ADV_FSP.2)

<u>Developer Action Elements</u>:

ADV_FSP2.1D
The developer shall provide a functional specification.

<u>Content and Presentation of Evidence Elements:</u>

ADV_FSP.2.1C
The functional specification shall describe the TSF and its external interfaces using an informal style.

ADV_FSP.2.2C
The functional specification shall be internally consistent.

ADV_FSP.2.3C
The functional specification shall describe the purpose and method of use of all external TSF interfaces, providing complete details of all effects, exceptions and error messages.

ADV_FSP.2.4C
The functional specification shall completely represent the TSF.

ADV_FSP.2.5C
The functional specification shall include rationale that the TSF is completely represented.

<u>Evaluator Action Elements:</u>

ADV_FSP.2.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

ADV_FSP.2.2E
The evaluator shall determine that the functional specification is an accurate and complete instantiation of the TOE security functional requirements.

5.2.3.3 Security enforcing high-level design (ADV_HLD.2)

<u>Developer Action Elements</u>:

ADV_HLD.2.1D
The developer shall provide the high-level design of the TSF.

<u>Content and Presentation of Evidence Elements:</u>

ADV_HLD.2.1C
The presentation of the high-level design shall be informal.

ADV_HLD.2.2C
The high-level design shall be internally consistent.

ADV_HLD.2.3C
The high-level design shall describe the structure of the TSF in terms of subsystems.

ADV_HLD.2.4C
The high-level design shall describe the security functionality provided by each subsystem of the TSF.

ADV_HLD.2.5C
The high-level design shall identify any underlying hardware, firmware, and/or software required by the TSF with a presentation of the functions provided by the supporting protection mechanisms implemented in that hardware, firmware, or software.

ADV_HLD.2.6C
The high-level design shall identify all interfaces to the subsystems of the TSF.

ADV_HLD.2.7C
The high-level design shall identify which of the interfaces to the subsystems of the TSF are externally visible.

ADV_HLD.2.8C
The high-level design shall describe the purpose and method of use of all interfaces to the subsystems of the TSF, providing details of effects, exceptions and error messages, as appropriate.

ADV_HLD.2.9C
The high-level design shall describe the separation of the TOE into TSP-enforcing and other subsystems.

Evaluator Action Elements:

ADV_HLD.2.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

ADV_HLD.2.2E
The evaluator shall determine that the high-level design is an accurate and complete instantiation of the TOE security functional requirements.

5.2.3.4 Subset of the implementation of the TSF (ADV_IMP.1)

Developer Action Elements:

ADV_IMP.1.1D
The developer shall provide the implementation representation for a selected subset of the TSF.

(Refinement) to include at least the following subsets:

(a) the subset of the physical structure of the TOE related to
  1. structure size, organization, and layout
  2. interconnects and data bus layout
  3. fuse locations
  4. physical structure including shielding layers and packaging
  5. EEPROM manipulation
  6. RAM access

(b) the subset of the logical structure of the TOE related to
  1. command range and validity checking
  2. interrupts and reset function
  3. secure data checking and manipulation
  4. availability of commands outside of defined application
  5. transfer of information between applications or functions

(c) the subset of the structure of the TOE related to unalterability of
  1. unique serial number and other life-cycle identifiers
  2. blocking or elimination of debugging functions

Content and Presentation of Evidence Elements:

ADV_IMP.1.1C
The implementation representation shall unambiguously define the TSF to a level of detail such that the TSF can be generated without further design decisions.

ADV_IMP.1.2C
The implementation representation shall be internally consistent.

Evaluator Action Elements:

ADV_IMP.1.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

ADV_IMP.1.2E
The evaluator shall determine that the least abstract TSF representation provided is an accurate and complete instantiation of the TOE security functional requirements.

5.2.3.5 Descriptive low-level design (ADV_LLD.1)

Developer Action Elements:

ADV_LLD.1.1D
The developer shall provide the low-level design of the TSF.

Content and Presentation of Evidence Elements:

ADV_LLD.1.1C
The presentation of the low-level design shall be informal.

ADV_LLD.1.2C
The low-level design shall be internally consistent.

ADV_LLD.1.3C
The low-level design shall describe the TSF in terms of modules.

ADV_LLD.1.4C
The low-level design shall describe the purpose of each module.

ADV_LLD.1.5C
The low-level design shall define the interrelationships between the modules in terms of provided security functionality and dependencies on other modules.

ADV_LLD.1.6C
The low-level design shall describe how each TSP-enforcing function is provided.

ADV_LLD.1.7C
The low-level design shall identify all interfaces to the modules of the TSF.

ADV_LLD.1.8C
The low-level design shall identify which of the interfaces to the modules of the TSF are externally visible.

ADV_LLD.1.9C
The low-level design shall describe the purpose and method of use of all interfaces to the modules of the TSF, providing details of effects, exceptions and error messages, as appropriate.

ADV_LLD.1.10C
The low-level design shall describe the separation of the TOE into TSP-enforcing and other modules.

<u>Evaluator Action Elements:</u>

ADV_LLD.1.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

ADV_LLD.1.2E
The evaluator shall determine that the low-level design is an accurate and complete instantiation of the TOE security functional requirements.

5.2.3.6 Informal correspondence demonstration (ADV_RCR.1)

<u>Developer Action Elements</u>:

ADV_RCR.1.1D
The developer shall provide an analysis of correspondence between all adjacent pairs of TSF representations that are provided.

<u>Content and Presentation of Evidence Elements:</u>

ADV_RCR.1.1C
For each adjacent pair of provided TSF representations, the analysis shall demonstrate that all relevant security functionality of the more abstract TSF representation is correctly and completely refined in the less abstract TSF representation.

Evaluator Action Elements:

ADV_RCR.1.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

5.2.3.7 Informal TOE security policy model (ADV_SPM.1)

Developer Action Elements:

ADV_SPM.1.1D
The developer shall provide a TSP model.

ADV_SPM.1.2D
The developer shall demonstrate correspondence between the functional specification and the TSP model.

Content and Presentation of Evidence Elements:

ADV_SPM.1.1C
The TSP model shall be informal.

ADV_SPM.1.2C
The TSP model shall describe the rules and characteristics of all policies of the TSP that can be modeled.

ADV_SPM.1.3C
The TSP model shall include a rationale that demonstrates that it is consistent and complete with respect to all policies of the TSP that can be modeled.

ADV_SPM.1.4C
The demonstration of correspondence between the TSP model and the functional specification shall show that all of the security functions in the functional specification are consistent and complete with respect to the TSP model.

Evaluator Action Elements:

ADV_SPM.1.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

5.2.4 Guidance documents (AGD)

5.2.4.1 Administrator guidance (AGD_ADM.1)

Developer Action Elements:

AGD_ADM.1.1D
The developer shall provide administrator guidance addressed to system administrative personnel.

Content and Presentation of Evidence Elements:

AGD_ADM.1.1C
The administrator guidance shall describe the administrative functions and interfaces available to the administrator of the TOE.

AGD_ADM.1.2C
The administrator guidance shall describe how to administer the TOE in a secure manner.

AGD_ADM.1.3C
The administrator guidance shall contain warnings about functions and privileges that should be controlled in a secure processing environment.

AGD_ADM.1.4C
The administrator guidance shall describe all assumptions regarding user behavior that are relevant to secure operation of the TOE.

AGD_ADM.1.5C
The administrator guidance shall describe all security parameters under the control of the administrator, indicating secure values as appropriate.

AGD_ADM.1.6C
The administrator guidance shall describe each type of security-relevant event relative to the administrative functions that need to be performed, including changing the security characteristics of entities under the control of the TSF.

AGD_ADM.1.7C
The administrator guidance shall be consistent with all other documentation supplied for evaluation.

AGD_ADM.1.8C
The administrator guidance shall describe all security requirements for the IT environment that are relevant to the administrator.

Evaluator Action Elements:

AGD_ADM.1.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

5.2.4.2 User guidance (AGD_USR.1)

Developer Action Elements:

AGD_USR.1.1D
The developer shall provide user guidance.

Content and Presentation of Evidence Elements:

AGD_USR.1.1C
The user guidance shall describe the functions and interfaces available to the non-administrative users of the TOE.

AGD_USR.1.2C
The user guidance shall describe the use of user-accessible security functions provided by the TOE.

AGD_USR.1.3C
The user guidance shall contain warnings about user-accessible functions and privileges that should be controlled in a secure processing environment.

AGD_USR.1.4C
The user guidance shall clearly present all user responsibilities necessary for secure operation of the TOE, including those related to assumptions regarding user behavior found in the statement of TOE security environment.

AGD_USR.1.5C
The user guidance shall be consistent with all other documentation supplied for evaluation.

AGD_USR.1.6C
The user guidance shall describe all security requirements for the IT environment that are relevant to the user.

Evaluator Action Elements:

AGD_USR.1.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

5.2.5 Life cycle support (ALC)

5.2.5.1 Identification of security measures (ALC_DVS.1)

Developer Action Elements:

ALC_DVS.1.1D
The developer shall produce development security documentation.

Content and Presentation of Evidence Elements:

ALC_DVS.1.1C
The development security documentation shall describe all the physical, procedural, personnel, and other security measures that are necessary to protect the confidentiality and integrity of the TOE design and implementation in its development environment.

(Refinement) The TOE design and implementation is refined to include at least the following:

(a) Design Information
1. IC specification and technology
2. IC design
3. IC hardware security mechanisms
4. IC software security mechanisms
5. photomask
6. development tools
7. initialization procedures
8. access control mechanisms
9. authentication systems
10. data protection systems
11. memory partitioning
12. cryptographic programs

(b) Data
1. initialization data
2. personalization data
3. passwords
4. cryptographic keys

(c) Test Information
1. test tools
2. test procedures
3. test programs
4. test results

(d) Physical Instantiations
1. silicon samples
2. bond-out chips
3. pre-initialized cards
4. pre-personalized cards
5. personalized but unissued cards

ALC_DVS.1.2C
The development security documentation shall provide evidence that these security measures are followed during the development and maintenance of the TOE.

<u>Evaluator Action Elements:</u>

ALC_DVS.1.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

ALC_DVS.1.2E
The evaluator shall confirm that the security measures are being applied.

5.2.5.2 Developer defined life-cycle model (ALC_LCD.1)

<u>Developer Action Elements</u>:

ALC_LCD.1.1D
The developer shall establish a life-cycle model to be used in the development and maintenance of the TOE.

ALC_LCD.1.2D
The developer shall provide life-cycle definition documentation.

<u>Content and Presentation of Evidence Elements:</u>

ALC_LCD.1.1C
The life-cycle definition documentation shall describe the model used to develop and maintain the TOE.

ALC_LCD.1.2C
The life-cycle model shall provide for the necessary control over the development and maintenance of the TOE.

Evaluator Action Elements:

ALC_LCD.1.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

5.2.5.3 Well-defined development tools (ALC_TAT.1)

Developer Action Elements:

ALC_TAT.1.1D
The developer shall identify the development tools being used for the TOE.

ALC_TAT.1.2D
The developer shall document the selected implementation-dependent options of the development tools.

Content and Presentation of Evidence Elements:

ALC_TAT.1.1C
All development tools used for implementation shall be well-defined.

ALC_TAT.1.2C
The documentation of the development tools shall unambiguously define the meaning of all statements used in the implementation.

ALC_TAT.1.3C
The documentation of the development tools shall unambiguously define the meaning of all implementation-dependent options.

Evaluator Action Elements:

ALC_TAT.1.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

5.2.6 Tests (ATE)

5.2.6.1 Analysis of coverage (ATE_COV.2)

Developer Action Elements:

ATE_COV.2.1D
The developer shall provide an analysis of the test coverage.

Content and Presentation of Evidence Elements:

ATE_COV.2.1C
The analysis of the test coverage shall demonstrate the correspondence between the tests identified in the test documentation and the TSF as described in the functional specification.

ATE_COV.2.2C
The analysis of the test coverage shall demonstrate that the correspondence between the TSF as described in the functional specification and the tests identified in the test documentation is complete.

Evaluator Action Elements:

ATE_COV.2.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

5.2.6.2 Testing: high-level design (ATE_DPT.1)

Developer Action Elements:

ATE_DPT.1.1D
The developer shall provide the analysis of the depth of testing.

Content and Presentation of Evidence Elements:

ATE_DPT.1.1C
The depth analysis shall demonstrate that the tests identified in the test documentation are sufficient to demonstrate that the TSF operates in accordance with its high-level design.

Evaluator Action Elements:

ATE_DPT.1.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

5.2.6.3 Functional testing (ATE_FUN.1)

Developer Action Elements:

ATE_FUN.1.1D
The developer shall test the TSF and document the results.

ATE_FUN.1.2D
The developer shall provide test documentation.

Content and Presentation of Evidence Elements:

ATE_FUN.1.1C
The test documentation shall consist of test plans, test procedure descriptions, expected test results and actual test results.

ATE_FUN.1.2C
The test plans shall identify the security functions to be tested and describe the goal of the tests to be performed.

ATE_FUN.1.3C
The test procedure descriptions shall identify the tests to be performed and describe the scenarios for testing each security function. These scenarios shall include any ordering dependencies on the results of other tests.

ATE_FUN.1.4C
The expected test results shall show the anticipated outputs from a successful execution of the tests.

ATE_FUN.1.5C
The test results from the developer execution of the tests shall demonstrate that each tested security function behaved as specified.

Evaluator Action Elements:

ATE_FUN.1.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

5.2.6.4 Independent testing—sample (ATE_IND.2)

<u>Developer Action Elements</u>:

ATE_IND.2.1D
The developer shall provide the TOE for testing.

<u>Content and Presentation of Evidence Elements:</u>

ATE_IND.2.1C
The TOE shall be suitable for testing.

ATE_IND.2.2C
The developer shall provide an equivalent set of resources to those that were used in the developer's functional testing of the TSF.

<u>Evaluator Action Elements:</u>

ATE_IND.2.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

ATE_IND.2.2E
The evaluator shall test a subset of the TSF as appropriate to confirm that the TOE operates as specified.

ATE_IND.2.3E
The evaluator shall execute a sample of tests in the test documentation to verify the developer test results.

5.2.7 Vulnerability assessment (AVA)

5.2.7.1 Validation of analysis (AVA_MSU.2)

<u>Developer Action Elements</u>:

AVA_MSU.2.1D
The developer shall provide guidance documentation.

AVA_MSU.2.2D
The developer shall document an analysis of the guidance documentation.

Content and Presentation of Evidence Elements:

AVA_MSU.2.1C
The guidance documentation shall identify all possible modes of operation of the TOE (including operation following failure or operational error), their consequences, and implications for maintaining secure operation.

AVA_MSU.2.2C
The guidance documentation shall be complete, clear, consistent and reasonable.

AVA_MSU.2.3C
The guidance documentation shall list all assumptions about the intended environment.

AVA_MSU.2.4C
The guidance documentation shall list all requirements for external security measures (including external procedural, physical and personnel controls).

AVA_MSU.2.5C
The analysis documentation shall demonstrate that the guidance documentation is complete.

Evaluator Action Elements:

AVA_MSU.2.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

AVA_MSU.2.2E
The evaluator shall repeat all configuration and installation procedures, and other procedures selectively, to confirm that the TOE can be configured and used securely using only the supplied guidance documentation.

AVA_MSU.2.3E
The evaluator shall determine that the use of the guidance documentation allows all insecure states to be detected.

AVA_MSU.2.4E
The evaluator shall confirm that the analysis documentation shows that guidance is provided for the secure operation in all modes of operation of the TOE.

5.2.7.2 Strength of TOE security function evaluation (AVA_SOF.1)

Developer Action Elements:

AVA_SOF.1.1D
The developer shall perform a strength of TOE security function analysis for each mechanism identified in the ST as having a strength of TOE security function claim.

Content and Presentation of Evidence Elements:

AVA_SOF.1.1C
For each mechanism with a strength of TOE security function claim the strength of TOE security function analysis shall show that it meets or exceeds the minimum strength level defined in the PP/ST.

AVA_SOF.1.2C
For each mechanism with a specific strength of TOE security function claim the strength of TOE security function analysis shall show that it meets or exceeds the specific strength of function metric defined in the PP/ST.

Evaluator Action Elements:

AVA_SOF.1.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

AVA_SOF.1.2E
The evaluator shall confirm that the strength claims are correct.

5.2.7.3 Moderately resistant (AVA_VLA.3)

Developer Action Elements:

AVA_VLA.3.1D
The developer shall perform and document an analysis of the TOE deliverables searching for ways in which a user can violate the TSP.

AVA_VLA.3.2D
The developer shall document the disposition of identified vulnerabilities.

Content and Presentation of Evidence Elements:

AVA_VLA.3.1C
The documentation shall show, for all identified vulnerabilities, that the vulnerability cannot be exploited in the intended environment for the TOE.

(Refinement) The analysis shall take into account the following generic vulnerabilities:
(a) The TOE may be subject to deconstruction to reveal internal circuits and structures.
(b) The TOE may be subject to tampering with the structure and content of internal memories, data transport mechanisms, security functions, and test methods.
(c) The TOE may be subject to analysis of information that is internal to the device through monitoring of connections between elements of the circuits and structures.
(d) The TOE may be subject to use of logical commands to produce responses that lead to security vulnerabilities.
(e) The TOE may be subject to manipulations outside defined operational boundaries that lead to security vulnerabilities.
(f) The TOE may be subject to analysis of information that is available external to the device, through monitoring emanations or any of the connections to the device including power, ground, clock, I/O, and reset.
(g) The TOE may be subject to vulnerabilities that have been identified in preceding generations of the same, or a similar, TOE.

AVA_VLA.3.2C
The documentation shall justify that the TOE, with the identified vulnerabilities, is resistant to obvious penetration attacks.

AVA_VLA.3.3C
The evidence shall show that the search for vulnerabilities is systematic.

<u>Evaluator Action Elements:</u>

AVA_VLA.3.1E
The evaluator shall confirm that the information provided meets all requirements for content and presentation of evidence.

AVA_VLA.3.2E
The evaluator shall conduct penetration testing, building on the developer vulnerability analysis, to ensure the identified vulnerabilities have been addressed.

AVA_VLA.3.3E
The evaluator shall perform an independent vulnerability analysis.

AVA_VLA.3.4E
The evaluator shall perform independent penetration testing, based on the independent vulnerability analysis, to determine the exploitability of additional identified vulnerabilities in the intended environment.

AVA_VLA.3.5E
The evaluator shall determine that the TOE is resistant to penetration attacks performed by an attacker possessing a moderate attack potential.

6 Rationale

6.1 TOE Description Rationale

The target of evaluation, a DoD PKI Token, has been defined. This TOE has a unique set of threats relating to its character as a small, self-contained microprocessor that is manufactured in large quantities and may ultimately be issued to untrusted token holders for their long-term retention. The description of the TOE supports the statement of threats, policies, and assumptions discussed earlier in this PP.

6.2 Security Objectives Rationale

This section demonstrates that the stated security objectives counter all identified threats, policies, or assumptions.

Table 6-1 and Table 6-2 map the security objectives to the security environment defined by the threats, policies, and assumptions. The mappings illustrate that each security objective covers at least one threat, policy, or assumption, and that each threat, policy, and assumption is covered by at least one security objective.

Table 6-1 Mapping the TOE Security Environment to Security Objectives

Policy/Threat/Assumptions	Security Objectives for the TOE
P.Protection_Mechanisms	O.DAC, O.Authenticate, O.Key_Encrypt, O.Auth_Protect, O.SSO_Data
P.Key_Length	O.Crypt
T.App_Ftn	O.Mult_App
T.Bad_Load	O.Self_Test, O.Authenticate, O.SSO_Data
T.Clon	O.Phys_Prot, O.Tamper_Response
T.Component_Fail	O.Fail_Secure
T.Crypt_Attk	O.Crypt
T.E_Manip	O.Phys_Prot, O.Tamper_Response
T.Env_Strs	O.Env_Strs
T.Fail_Secure	O.Log_Prot, O.Env_Strs, O.Init
T.First_Use	O.Set_Up
T.Flt_Ins	O.Input_Probe
T.Forced_State_Change	O.Init
T.Hacker_Comm_Eavesdrop	O.I_Leak, O.Secure_Host_Comms, O.Tamper_Response, O.Data_Exchange_Conf
T.I_Leak	O.I_Leak, O.Env_Strs
T.Impers	O.Trial, O.Auth_Protect, O.Authenticate

Policy/Threat/Assumptions	Security Objectives for the TOE
T.Inv_Inp	O.Init, O.Log_Prot
T.LC_Ftn	O.Life_Cycle
T.Link	O.Unlink
T.Lnk_Att	O.Log_Prot
T.P_Modify	O.Tamper_Response, O.Phys_Prot
T.P_Probe	O.Tamper_Response, O.Key_Encrypt, O.Volatile_Memory, O.Auth_Protect, O.D_Read, O.Phys_Prot
T.Power_Clock	O.Env_Strs, O.Fail_Secure
T.Rep_Atk	O.Env_Strs, O.Log_Prot, O.Trial, O.DAC
T.Res_Con	O.Res_Access
T.Spoof	O.Secure_Host_Comms
T.UA_Use	O.Init, O.Log_Prot, O.Self_Test
Policy/Threat/Assumptions	**Security Objectives for the Environment**
A.Dev_Protect	OE.Con_Prod, OE.Con_Tools, OE.Mask_Prot
A.Key_Gen	OE.Key_Gen
A.Role_Man	OE.Role_Man
A.Secure_Host_Comms	OE.Sec_Com, OE.Dlv_Proc
T.Bad_Load	OE.Personnel, OE.Sec_Com
T.Clon	OE.Con_Des, OE.Dlv_Aud, OE.Dlv_Proc, OE.Ident, OE.Sample_Acs
T.Developer_Flawed_Code	OE.Con_Cont, OE.Con_Des, OE.Con_Prod, OE.Dlv_Aud, OE.Dlv_Proc, OE.Dlv_Trn, OE.SW_Develop
T.Hacker_Social_Engineer	OE.Personnel, OE.Train
T.Inv_Inp	OE.Train
T.Privilege	OE.Personnel

Table 6-2 Tracing of Security Objectives to the TOE Security Environment

Security Objectives for the TOE	Policy/Threat/Assumptions
O.Auth_Protect	P.Protection_Mechanisms, T.Impers, T.P_Probe
O.Authenticate	P.Protection_Mechanisms, T.Bad_Load, T.Impers
O.Crypt	T.Crypt_Attk, P.Key_Length
O.DAC	P.Protection_Mechanisms, T.Rep_Atk
O.D_Read	T.P_Probe
O.Data_Exchange_Conf	T.Hacker_Comm_Eavesdrop
O.Env_Strs	T.Env_Strs, T.Fail_Secure, T.I_Leak, T.Power_Clock, T.Rep_Atk
O.Fail_Secure	T.Component_Fail, T.Power_Clock
O.I_Leak	T.Hacker_Comm_Eavesdrop, T.I_Leak
O.Init	T.Fail_Secure, T.Forced_State_Change, T.Inv_Inp, T.UA_Use
O.Input_Probe	T.Flt_Ins
O.Key_Encrypt	P.Protection_Mechanisms, T.P_Probe
O.Life_Cycle	T.LC_Ftn
O.Log_Prot	T.Fail_Secure, T.Inv_Inp, T.Lnk_Att, T.Rep_Atk, T.UA_Use
O.Mult_App	T.App_Ftn
O.Phys_Prot	T.Clon, T.E_Manip, T.P_Probe, T.P_Modify
O.Res_Access	T.Res_Con
O.SSO_Data	P.Protection_Mechanisms, T.Bad_Load
O.Secure_Host_Comms	T.Hacker_Comm_Eavesdrop, T.Spoof
O.Self_Test	T.Bad_Load, T.UA_Use
O.Set_Up	T.First_Use
O.Tamper_Response	T.Clon, T.E_Manip, T.Hacker_Comm_Eavesdrop, T.P_Modify, T.P_Probe
O.Trial	T.Impers, T.Rep_Atk
O.Unlink	T.Link
O.Volatile_Memory	T.P_Probe

Security Objectives for the Environment	Policy/Threat/Assumptions
OE.Con_Cont	T. Developer_Flawed_Code
OE.Con_Des	T.Clon, T.Developer_Flawed_Code
OE.Con_Prod	A.Dev_Protect, T.Developer_Flawed_Code
OE.Con_Tools	A.Dev_Protect
OE.Dlv_Aud	T.Clon, T.Developer_Flawed_Code
OE.Dlv_Proc	A.Secure_Host_Comms, T.Clon, T.Developer_Flawed_Code
OE.Dlv_Trn	T.Developer_Flawed_Code
OE.Ident	T.Clon
OE.Key_Gen	A.Key_Gen
OE.Mask_Prot	A.Dev_Protect
OE.Personnel	T.Bad_Load, T.Hacker_Social_Engineer, T.Privilege
OE.Role_Man	A.Role_Man

OE.SW_Develop	T.Developer_Flawed_Code
OE.Sample_Acs	T.Clon
OE.Sec_Com	A.Secure_Host_Comms, T.Bad_Load
OE.Train	T.Hacker_Social_Engineer, T.Inv_Inp

6.2.1 Assumptions

A.Dev_Protect: Protection of TOE by Developer
During the development and manufacturing process, the TOE and associated development tools are assumed to be protected by the developer from any kind of unauthorized use, e.g., tampering or theft.

***Coverage Rationale*:** A.Dev_Protect (Protection of TOE by Developer) establishes that the TOE and its development tools are protected by the developer from unauthorized use during the TOE's development and manufacturing phases. OE.Con_Prod (Control of Product), OE.Con_Tools (Control of Tools) , and OE.Mask_Prot (Photomask Protection) ensure this protection.

A.Key_Gen: Key Exchange Key Generation
Key exchange keys are assumed to be generated off-TOE in a secure manner in accordance with X.509 Certificate Policy.

***Coverage Rationale*:** A.Key_Gen (Key Generation) establishes that key exchange keys were generated in a secure manner before being loaded onto the TOE. This assumption is supported by OE.Key_Gen (Key Exchange Key Generation) that ensures Key Exchange Keys are securely generated in accordance with X.509 Certificate Policy.

A.Role_Man: Role Management
Management of roles for the TOE is performed in a secure manner off-TOE.

***Coverage Rationale*:** A.Role_Man (Role Management) establishes that the roles necessary for proper use of the TOE need to be managed external to the TOE. OE.Role_Man (Role Management) provides for that management in the environment.

A.Secure_Host_Comms: Secure Host Communications
If the host establishes a secure connection between itself and the TOE that conforms to the requirements imposed by the TOE, the host, including code and security data it contains, is assumed to be trusted.

***Coverage Rationale*:** A.Secure_Host_Comms (Secure Host Communications) establishes that the host, its code, and its security data are trusted by the TOE, provided that a secure connection is established between the host and the TOE. OE.Sec_Com (Secure Communication) ensures that only a trusted host is able to establish a secure connection with the TOE. OE.Dlv_Proc (Delivery Procedures) ensures that the code and security data on the host are protected during their delivery to the host.

6.2.2 Policies

P.Protection_Mechanisms: Application of Protection Mechanisms
Information Assurance Guidance and Policy Memorandum 6-8510. Protection mechanisms shall be applied such that the TOE maintains the appropriate level of confidentiality, integrity, authentication, and nonrepudiation based on mission criticality, sensitivity of information handled by the system, and need-to-know.

***Coverage Rationale*:** P.Protection_Mechanisms (Application of Protection Mechanisms) addresses unauthorized access to DoD information or resources by legitimate users and applications. O.Authenticate and O.Auth_Protect guarantee that the subject making an access to cryptographic or other DoD data is who he or she claims. O.SSO_Data (Data Initialized by SSO) restricts setting sensitive information to the SSO. By O.DAC, each user has the means of limiting access for its objects and resources to authorized users. O.Key_Encrypt provides further protection by preventing the reading of keys in nonvolatile memory.

P.Key_Length: Cryptographic Key Length
X.509 Certificate Policy for the U. S. Department of Defense. Digital Signature Standard keys shall use at least 160 bit private key and at least 1024 bit prime modulus. Minimum public key size shall be 1024 bits for Key Exchange Algorithm (KEA). Minimum public key size shall be 2048 bits for RSA. For Class 4, Elliptic Curve Digital Signature Algorithm key prime field (//p//) shall be not less than 384 bits.

***Coverage Rationale*:** P.Key_Length (Cryptographic Key Length) addresses the required key length for digital signatures and public key cryptography. O.Crypt ensures that cryptographic operations are performed in accordance with established policies for SBU data.

6.2.3 Threats

T.App_Ftn: Use of Unallowed Application Functions
An attacker may exploit interactions between applications to expose sensitive TOE or user data.

***Coverage Rationale*:** T.App_Ftn (Use of Unallowed Application Functions) deals with the exploitation of inappropriate interaction of functions between applications. O.Mult_App (Multiple Applications) ensures that such interactions do not compromise security through unauthorized availability of information between applications.

T.Bad_Load: Load Bad Software or Security Data
An attacker, an SSO, or the user may load improper software (operating system, executable files) or security data (authentication information, keys, access control information) onto the TOE that could modify or expose software (e.g., security functions) or data on the TOE.

***Coverage Rationale*:** T.Bad_Load (Load Bad Software or Security Data) addresses the risk that improper software or security data could cause software or data on the TOE to be improperly modified or exposed. O.Authenticate (Authentication of Users and SSO) and O.SSO_Data (Data Initialized by SSO) ensure that security data with which the TOE is initialized is supplied by an authenticated SSO, and OE.Personnel ensures that the SSO is carefully selected and trained for reliability. OE.Sec_Com (Secure Communication) guarantees that the host from which the software or security data is downloaded is trusted and, therefore, the software or data are appropriate for the TOE. Additionally, O.Self_Test (Self-Test) checks that the execution of bad code does not modify other code.

T.Clon: Cloning
An attacker may clone part or all of a functional TOE to develop further attacks.

***Coverage Rationale*:** T.Clon (Cloning) represents the threat that an attacker may manufacture all or a usable portion of the IC that is then used for fraudulent purposes. This threat is countered by O.Phys_Prot (Physical Protection) through a construction that makes it difficult to understand any information derived from physical attacks on the TOE. By O.Tamper_Response (Respond to Tamper), the TOE automatically responds to physical attempts to extract information, thereby preventing an attacker from obtaining the design of the IC. This is also supported by OE.Con_Des (Control of Design), which ensures the protection of design and fabrication information supporting the construction of the IC. The objectives OE.Dlv_Proc (Delivery Procedures) and OE.Dlv_Aud (Delivery Audit) also provide support through ensuring that information, designs, and product (in various states of completion) are not available to attackers. OE.Sampl_Acs (Sample Access) limits access to the samples used to run tests to authorized personnel, preventing others from gaining access to this privileged information. OE.Ident (TOE Identification) counters cloning attacks to ensure TOE identification information is recorded and preserved on the TOE prior to being issued to the user.

T.Component_Fail: Failure of a Critical System Component
An attacker exploits a failure of one or more system components resulting in the loss of system-critical functionality.

***Coverage Rationale*:** T.Component_Fail (Failure of a Critical System Component) addresses the failure of one or more system components, resulting in the failure of security-critical functionality. O.Fail_Secure (Preservation of secure state) ensures that if a security component does fail, the system will remain secure.

T.Crypt_Attk: Cryptographic Attack
An attacker may defeat security functions through a cryptographic attack against the algorithm, through cryptanalysis on encrypted data, or through a brute-force attack.

***Coverage Rationale*:** T.Crypt_Attk (Cryptographic Attack) addresses direct attacks on the cryptographic mechanisms employed in the TOE. This threat is countered by O.Crypt (Cryptography), which ensures that the available cryptographic functions are of appropriate strength for the sensitivity of the data processed by the TOE.

T.Developer_Flawed_Code: Software containing security related flaws
An attacker exploits code delivered by a system or application developer that does not perform according to specifications, contains security flaws, or is not appropriate for operational use.

***Coverage Rationale*:** T.Developer_Flawed_Code (Software containing security-related flaws) addresses flaws in the system or developer's application code. OE.SW_Develop (Software Developer Process) ensures that the developer's software development process for the code is reliable. The design information, by OE.Con_Des (Control of Design), and the code, by OE.Con_Prod (Control of Product) and OE.Con_Cont (Code Configuration Control), are protected from unauthorized modification. OE.Dlv_Proc (Delivery Procedures), OE.Dlv_Aud (Delivery Audit), and OE.Dlv_Trn (Delivery Training) protect the software while it is transferred from one facility or supplier to another.

T.E_Manip: Electrical Manipulation of the IC
An attacker may use electrical probing and manipulation of the TOE to modify security-critical data so that the TOE can be used fraudulently.

***Coverage Rationale*:** T.E_Manip (Electrical Manipulation of the IC) addresses attempts in which the TOE is modified so that it can be directly fraudulently used. This differs from T.P_Modify in that the goal of the former threat is to derive information and not to reuse the TOE. This threat is countered directly by O.Phys_Prot (Physical Protection), which ensures that the TOE is resistant to physical attack. The threat is additionally countered by O.Tamper_Response, which provides capabilities to automatically respond to physical attacks against specified parts of the TOE. The automatic response may take varying forms but generally involves direct actions (e.g., shutting a system down) rather than notification actions. The combination of O.Phys_Prot and O.Tamper_Response provides a two-phased approach to countering E.Manip by protecting the TOE from manipulation and invoking a TOE response to manipulation when detected.

T.Env_Strs: Environmental Stress
An attacker may exploit failures in the TOE induced by environmental stress.

***Coverage Rationale*:** T.Env_Strs (Environmental Stress) deals with the imposition of environmental extremes on the TOE with the intent to cause a direct or indirect failure in the security mechanisms. This threat is countered by O.Env_Strs (Environmental Stress), which ensures that the TOE performs in an acceptable fashion (i.e., does not reveal secure information) when exposed to out-of-design-specification conditions.

T.Fail_Secure: Failing in a nonsecure state
An attacker may cause failure of the TOE security functions, causing the TOE to enter a nonsecure state.

Coverage Rationale**:** T.Fail_Secure addresses forcing the TOE into a nonsecure state by causing the failure of TOE security functions. This threat is countered by O.Log_Prot, which ensures that the TOE is constructed to be resistant to logical manipulation. This threat is also countered by O.Env_Strs, which ensures that the TOE performs in a secure fashion (i.e., does not reveal security information) when exposed to out-of-design-specification conditions. Additionally, this threat is addressed by O.Init, which requires that the TOE enter a defined initial state upon experiencing a reset condition.

T.First_Use: Fraud on First Use
An attacker may gain access to TOE information by unauthorized use of a new, previously unissued TOE.

Coverage Rationale**:** T.First_Use (Fraud on First Use) deals with fraud perpetrated through the use of TOEs that have not been officially issued. This threat is countered directly by O.Set_Up (Set-up Sequence), which ensures that a defined and controlled sequence of events is completed before the TOE is enabled for use.

T.Flt_Ins: Insertion of Faults
An attacker may determine security-critical information through observation of the results of repetitive insertion of selected data.

Coverage Rationale**:** T.Flt_Ins addresses the situation when the TOE is actively being probed through the deliberate insertion of selected inputs with the intent of observing the outputs. This is normally performed over multiple repetitions with small changes in the selected inputs. This is countered through O.Input_Probe (Probing by Selected Input), which ensures that such attacks are resisted.

T.Forced_State_Change: Forced State Change
An attacker may force the TOE into a nonsecure state through inappropriate termination of selected operations.

Coverage Rationale**:** T.Forced_State_Change (Forced State Change) addresses the situations in which the TOE is reset during operation. This may occur at any time including during a reset operation itself. This threat is countered directly by O.Init (Initialization), which ensures that the TOE always enters its defined initial state upon reset.

T.Hacker_Comm_Eavesdrop: Hacker Eavesdrops on User Data Communications
Hacker obtains user data by eavesdropping on communications lines.

Coverage Rationale**:** T.Hacker_Comm_Eavesdrop addresses the tapping of cables between the host and the TOE (reader) to extract sensitive data. This threat is addressed by O.Tamper_Response, which responds to physical tampering against system devices and components. O.I_Leak addresses this threat by providing the means to control and limit the leakage of information in the TOE so that no useful information is revealed over the power, ground, clock, reset, or I/O lines. O.Data_Exchange_Conf helps in countering the tapping of communication lines by protecting user data confidentiality when exchanging data. O.Secure_Host_Comms counters this threat by establishing secure communications with the host before cryptographic or other DoD data are passed between the TOE and the host.

T.Hacker_Social_Engineer: Social Engineering
A hacker uses social engineering techniques to gain information about system entry, system use, system design, or system operation.

Coverage Rationale**:** T.Hacker_Social_Engineer addresses the use of social engineering techniques to gain information about the system. This threat is countered by OE.Train and OE.Personnel, which requires TOE users and administrators to be trained on the proper usage of the TOE and its security procedures.

T.I_Leak: Information Leak
An attacker may exploit information that is leaked from the TOE during normal usage.

Coverage Rationale**:** T.I_Leak (Information Leakage) deals with the exploitation of information inadvertently available from emanations or variations in power consumption or other operating parameters as a function of the operation being performed, i.e., Simple Power Analysis and Differential Power Analysis. This threat is countered by O.I_Leak (Information Leakage), which provides the means to control and limit leakage of information in the TOE and ensures that such information is not exposed. O.Env_Strs (Environmental Stress) ensures that the TOE performs in an acceptable fashion (i.e., does not reveal secure information) when exposed to out-of-design-specification conditions.

T.Impers: Impersonation
An attacker may gain access to TOE information by impersonating an authorized user of the TOE.

***Coverage Rationale*:** T.Impers (Unauthorized use of TOE) addresses the use of the TOE by an attacker impersonating an authorized user or SSO. This threat is countered directly by O.Trial (Trial and Error Resistance) and O.Authenticate (Authentication of User and SSO), which require that the user be authenticated with a mechanism resistant to spoofing by trial and error.

T.Inv_Inp: Invalid Input
An attacker or authorized user of the TOE may compromise the security features of the TOE through the introduction of invalid inputs.

***Coverage Rationale*:** T.Inv_Inp (Invalid Input) addresses the introduction of input that does not conform to the required style, content, or format. This input may have the look of accidental or erroneous entries (and that may be, in fact, the source of the data), but the result may be the misperformance of the TOE such that security is compromised. Attackers may use nonconforming data, existing but inappropriate commands, or well-formatted commands with data requests that refer to locations that are outside of range or not to be used in that operation. This threat is countered directly by O.Log_Prot (Logical Protection), which ensures that the TOE is constructed such that it responds in a secure manner to all probing represented by data, commands, or other input. This threat is also countered by O.Init (Initialization), which provides additional protection against this threat by ensuring the TOE starts in a defined and controlled state after a restart condition. This threat is also countered by OE.Train (User Train), which requires TOE users to be trained on the proper usage of the TOE and TOE-related security procedures.

T.LC_Ftn: Use of Unallowed Life-Cycle Functions
An attacker may exploit interactions between life-cycle functions to expose sensitive TOE or user data.

***Coverage Rationale*:** T.LC_Ftn (Use of Unallowed Life-Cycle Functions) deals with the exploitation of inappropriate interactions of functions between various life-cycle operations. O.Life_Cycle (Life-Cycle Functions) ensures that such interactions do not compromise security through unauthorized availability of information between elements used in different parts of the life cycle.

T.Link: Linkage of Multiple Observations
An attacker may observe multiple uses of resources or services and, by linking these observations, deduce information that would reveal critical security information.

***Coverage Rationale*:** T.Link (Linkage of Multiple Observations) addresses the observation and linking of a variety of operations, leading to the attacker being able to deduce useful information. This threat is differentiated from T.Alt_Ftn and T.Gen_Attk, since it purely entails observation of normally visible operations and not the manipulation entailed in using operations across defined boundaries. This threat is countered by O.Unlink (Linkage), which ensures that information exposed in a combination of operations is of no use to an attacker in understanding and attacking the TOE.

T.Lnk_Att: Linked Attacks
An attacker may perform successive attacks with the result that the TOE becomes unstable or some aspect of the security functionality is degraded. A following attack may then be successfully executed.

***Coverage Rationale*:** T.Lnk_Att (Linked Attacks) deals with multiple attacks synergistically causing a degradation and failure of TOE security. O.Log_Prot ensures that the TOE remains secure in the event of logical probing attacks.

T.P_Modify: Physical Modification of the IC
An attacker may physically modify the TOE in order to reveal design- or security-related information.

***Coverage Rationale*:** T.P_Modify (Physical Modification) deals with attempts to physically modify the TOE such that information relating to the secure operation of the TOE is revealed. This is an extension of T.P_Probe, since it may involve physical changes to the IC such as rerouting connections or repairing fuses. This threat is countered directly by O.Phys_Prot (Physical Protection), which ensures that the TOE is resistant to physical attack or is able to create difficulties in understanding the information derived from such an attack. Additionally, O.Tamper_Response (Tamper Response) provides capabilities to automatically respond to physical attacks against specified parts of the TOE, thereby resisting such attacks.

T.P_Probe: Physical Probing of the IC
An attacker may perform physical probing of the TOE to reveal design information and operational contents.

***Coverage Rationale*:** T.P_Probe (Physical Probing) deals with direct probing of the TOE using IC failure analysis and IC reverse engineering efforts to reveal critical hardware and software design information. This threat is countered directly by O.Phys_Prot (Physical Protection), which ensures that the TOE is resistant to physical attack or is able to create difficulties in understanding the information derived from such an attack. Additionally, O.Tamper_Response (Tamper Response) provides automatic response to physical attacks against specified parts of the TOE deemed critical, thereby resisting such attacks. This threat is also partially countered by O.D_Read (Data Read Format), which ensures that data available on data buses inside the TOE provide no information beyond that which would be available through statically reading the memory, that is, information is transferred in the same format in which it is stored. If a key is stored in nonvolatile memory, it is encrypted by O.Key_Encrypt. Thus, plain text keys are only stored in volatile memory. By O.Volatile_Mem, these keys are destroyed when the TOE is removed from a CAD. Likewise, O.Auth_Protect ensures that authentication data cannot be modified by physical probing.

T.Privilege: Abuse by Privileged Users
A careless, willfully negligent, or hostile administrator or other privileged user may compromise the TOE assets through execution of actions that expose, change, or destroy the security functions or the protected/security-critical data.

***Coverage Rationale*:** The threat of abuse by a privileged user is completely addressed by the OE.Personnel objective. OE.Personnel requires personnel working as administrators or in other privileged positions to be selected and trained for reliability.

T.Power_Clock: Power and Clock
An attacker may interrupt, reset, or alter TOE power or clock to disrupt security-critical functions.

***Coverage Rationale*:** T.Power_Clock (Power and Clock) deals with the interruption, reset, or alteration of TOE power or clock. This threat is countered by O.Env_Strs (Environmental Stress), which ensures that the TOE performs in an acceptable fashion (i.e., does not reveal secure information) when exposed to out-of-design-specification conditions. This threat is also addressed by O.Fail_Secure, which preserves the secure state of the system in the event of reset or interruption of power or clock.

T.Rep_Atk: Repetitive Attack
An attacker may utilize repetitive undetected attempts at penetration to expose memory contents or to change security-critical elements in the TOE.

***Coverage Rationale*:** T.Rep_Atk addresses repeated attempts at penetration aimed at exposing memory contents or to change security-critical elements in the TOE. This threat is addressed by several objectives. O.Trial protects the TOE against spoofing by trial and error. O.DAC addresses the access control rules for accessing the TOE. This threat is also countered by O.Log_Prot, which ensures that the TOE is constructed such that it responds in a secure manner to all probing represented by data, commands, or other input not fully conforming to the anticipated style and content. Finally, O.Env_Strs works to prevent disclosure of security-related information in the presence of environmental stress.

T.Res_Con: Resource Contention
A user or attacker may willfully, or through negligence, monopolize resources of the TOE, denying service to another user.

***Coverage Rationale*:** T.Res_Con (Resource Contention) addresses the utilization of an excessive amount of memory, program space, or other resource by a negligent user or an attacker, precluding further normal use of the TOE. This threat is countered by O.Res_Access

(Resource Access), which ensures that limits on resource allocations are established to preclude this denial of service.

T.Spoof: Spoofing Legitimate System Services
An attacker tricks users into interacting with spurious system services, e.g., an unauthorized (bogus) terminal, that request sensitive information from the TOE.

***Coverage Rationale*:** This threat is countered by ensuring that only trusted hosts may communicate with the TOE. O.Secure_Host_Communications requires that DoD and cryptographic data be transmitted only over a secure channel. By A.Secure_Host_Comms, only trusted hosts can establish such a path.

T.UA_Use: Unauthorized Program Use
An attacker may utilize unauthorized programs to penetrate or modify the security functions of the TOE.

***Coverage Rationale*:** T.UA_Use (Unauthorized Program Use) addresses the situations in which legitimate programs may exist in the TOE that are not to be used in the application then being performed. This threat is countered directly by O.Log_Prot (Logical Protection), which ensures the TOE is constructed such that it responds in a secure manner to all probing represented by data, commands, or other input that is not fully conforming to the anticipated style and content. O.Init (Initialization) provides additional protection against this threat by ensuring the TOE starts in a defined and controlled state after a restart condition. This threat is also addressed by O.Self_Test (Self-Test), which track and detect the use of legitimate operations used at times that are not allowed.

6.3 Security Requirements Rationale

Table 6-3 maps this PP's security objectives to the security requirements that support them.

Table 6-3 Requirements to Security Objectives Mapping

Objectives	Requirements
O.Auth_Protect	FPT_PHP.3
O.Authenticate	FIA_AFL.1, FIA_SOS.1, FIA_UAU.1, FIA_UAU.6, FIA_UAU.7
O.Crypt	FCS_CKM.1, FCS_CKM.2, FCS_CKM.4, FCS_COP.1
O.DAC	FDP_ACC.1, FDP_ACF.1, FIA_ATD.1, FIA_UAU.1, FIA_UAU.6, FMT_MOF.1, FMT_MSA.1, FMT_MSA.2, FMT_MSA.3, FMT_MTD.1, FMT_MTD.2, FMT_MTD.3,FMT_REV.1, FDP_ITC.1, FIA_UID.2, FDP_ETC.1
O.D_Read	FDP_ITT.1, FPT_ITT.1
O.Data_Exchange_Conf	FDP_ITC.1, FDP_ETC.1
O.Env_Strs	FPT_FLS.1, FPT_PHP.3

Objectives	Requirements
O.Fail_Secure	FPT_PHP.3, FPT_FLS.1, ADV_SPM.1
O.I_Leak	FPT_ITT.1, FDP_ITT.1, FDP_IFF.3
O.Init	FIA_UID.2, FPT_RCV.4
O.Input_Probe	FDP_DAU.1
O.Key_Encrypt	FCS_CKM.3
O.Life_Cycle	FDP_ACC.1, FDP_ACF.1
O.Log_Prot	FPT_PHP.3, ADV_IMP.1, FPT_FLS.1, FPT_PHP.1, FPT_RVM.1, FPT_SEP.1, AVA_VLA.3
O.Mult_App	FDP_IFF.1, FDP_ACC.1, FDP_IFC.1
O.Phys_Prot	FDP_DAU.1, FPT_PHP.1, FPT_PHP.3
O.Res_Access	FRU_RSA.1
O.SSO_Data	FDP_ACC.1, FDP_ACF.1
O.Secure_Host_Comms	FTP_ITC.1, FCS_CKM.1, FDP_UIT.1, FPT_ITI.1
O.Self_Test	FPT_TST.1, FPT_AMT.1
O.Set_Up	FDP_ACC.1, FDP_ACF.1
O.Tamper_Response	FDP_RIP.1, FPT_PHP.3
O.Trial	FIA_AFL.1, FIA_SOS.1
O.Unlink	FDP_ETC.1, FDP_IFC.1, FDP_IFF.1, FDP_ITT.1
O.Volatile_Memory	FPT_FLS.1
Selection of EAL4	ACM_CAP.4, ACM_SCP.2, ADO_DEL.2, ADO_IGS.1, ADV_CMM.1, ADV_FSP.2, ADV_HLD.2, ADV_IMP.1, ADV_LLD.1, ADV_RCR.1, ADV_SPM.1, AGD_ADM.1, AGD_USR.1, ALC_DVS.1, ALC_LCD.1, ALC_TAT.1, ATE_COV.2, ATE_DPT.1, ATE_FUN.1, ATE_IND.2, AVA_MSU.2, AVA_SOF.1, ACM_AUT.1

Table 6-4 shows the support relationship between the security requirements and objectives.

Table 6-4 Security Objectives to Requirements Mapping

Requirements	Objectives
ACM_AUT.1	Supporting Selection of EAL4
ACM_CAP.4	Supporting Selection of EAL4,O.Ident
ACM_SCP.2	Supporting Selection of EAL4
ADO_DEL.2	Supporting Selection of EAL4
ADO_IGS.1	Supporting Selection of EAL4
ADV_CMM.1	Supporting Selection of EAL4
ADV_FSP.2	Supporting Selection of EAL4
ADV_HLD.2	Supporting Selection of EAL4
ADV_IMP.1	Supporting Selection of EAL4, O.Ident, O.Log_Prot
ADV_LLD.1	Supporting Selection of EAL4
ADV_RCR.1	Supporting Selection of EAL4
ADV_SPM.1	Supporting Selection of EAL4, O.Fail_Secure
AGD_ADM.1	Supporting Selection of EAL4
AGD_USR.1	Supporting Selection of EAL4
ALC_DVS.1	Supporting Selection of EAL4

Requirements	Objectives
ALC_LCD.1	Supporting Selection of EAL4
ALC_TAT.1	Supporting Selection of EAL4
ATE_COV.2	Supporting Selection of EAL4
ATE_DPT.1	Supporting Selection of EAL4
ATE_FUN.1	Supporting Selection of EAL4
ATE_IND.2	Supporting Selection of EAL4
AVA_MSU.2	Supporting Selection of EAL4
AVA_SOF.1	Supporting Selection of EAL4
AVA_VLA.3	O.Log_Prot
FCS_CKM.1	O.Crypt, O.Secure_Host_Comms
FCS_CKM.2	O.Crypt
FCS_CKM.3	O.Key_Encrypt
FCS_CKM.4	O.Crypt
FCS_COP.1	O.Crypt
FDP_ACC.1	O.DAC, O.Life_Cycle, O.Set_Up, O.Mult_App, O.SSO_Data
FDP_ACF.1	O.DAC, O.Life_Cycle, O.Set_Up, O.SSO_Data
FDP_DAU.1	O.Input_Probe, O.Phys_Prot
FDP_ETC.1	O.DAC, O.Data_Exchange_Conf, O.Unlink
FDP_IFC.1	O.Mult_App, O.Unlink
FDP_IFF.1	O.Mult_App, O.Unlink
FDP_IFF.3	O.I_Leak
FDP_ITC.1	O.DAC, O.Data_Exchange_Conf
FDP_ITT.1	O.D_Read, O.I_Leak, O.Unlink
FDP_RIP.1	O. Tamper_Response
FDP_UIT.1	O.Secure_Host_Comms
FIA_AFL.1	O.Authenticate, O.Trial
FIA_ATD.1	O.DAC
FIA_SOS.1	O.Authenticate, O.Trial
FIA_UAU.1	O.Authenticate, O.DAC
FIA_UAU.6	O.Authenticate, O.DAC
FIA_UAU.7	O.Authenticate
FIA_UID.2	O.DAC, O.Init
FMT_MOF.1	O.DAC
FMT_MSA.1	O.DAC
FMT_MSA.2	O.DAC
FMT_MSA.3	O.DAC
FMT_MTD.1	O.DAC
FMT_MTD.2	O.DAC
FMT_MTD.3	O.DAC
FMT_REV.1	O.DAC
FMT_SMR.1	OE.Role_Man
FMT_SMR.3	OE.Role_Man
FPT_AMT.1	O.Self_Test
FPT_FLS.1	O.Env_Strs, O.Fail_Secure, O.Log_Prot, O.Volatile_Memory
FPT_ITI.1	O.Secure_Host_Comms

Requirements	Objectives
FPT_ITT.1	O.D_Read, O.I_Leak
FPT_PHP.1	O.Phys_Prot, O.Log_Prot
FPT_PHP.3	O.Env_Strs, O.Fail_Secure, O.Log_Prot, O.Tamper_Response, O.Phys_Prot
FPT_RCV.4	O.Init
FPT_RVM.1	O.Log_Prot
FPT_SEP.1	O.Log_Prot
FPT_TST.1	O.Self_Test
FRU_RSA.1	O.Res_Access
FTP_ITC.1	O.Secure_Host_Comms

6.3.1 Functional Security Requirements Rationale

O.Auth_Protect: Protection of Authentication Data
Authentication data maintained by the TOE will be protected from disclosure and modification.

***Coverage Rationale*:** O.Auth_Protect is provided by FPT_PHP.3 (Resistance to physical attack). This requirement provides features that prevent or resist physical tampering with authentication data.

O.Authenticate: Authentication of Users and SSO
Before cryptographic or other DoD data are accessed, either the user's identity or an administrative role will be authenticated by the TOE.

***Coverage Rationale*:** O.Authenticate is provided by FIA_AFL.1 (Authentication failure handling), FIA_SOS.1 (Verification of secrets), FIA_UAU.1 (Timing of authentication), FIA_UAU.6 (Re-authenticating), and FIA_UAU.7 (Protected authentication feedback). FIA_SOS.1 specifies the minimum length of secrets (passwords). FIA_UAU.1 covers when authentication is necessary. FIA_UAU.6 requires re-authentication of the user before actions for which the user can be held legally responsible or during periods of inactivity. FIA_UAU.7 requires that no feedback information is provided to the user during authentication. FIA_AFL.1 requires the termination of the session establishment process after a specified number of unsuccessful user authentication attempts. FIA_AFL.1 further requires that the TSF places the TOE into the Locked state when the number of allowed unsuccessful user authentication attempts is exceeded.

O.Crypt: Cryptography
The TOE must perform cryptographic functions with sufficient strength for Sensitive But Unclassified (SBU) data.

***Coverage Rationale*:** O.Crypt is implemented by FCS_COP.1 (Cryptographic operation) that specifies how the TOE will perform specific cryptographic operations. FCS_CKM.1

(Cryptographic key generation), FCS_CKM.2 (Cryptographic key distribution), and FCS_CKM.4 (Cryptographic key destruction) require that cryptographic keys be generated, distributed, and destroyed in accordance with specified methods.

O.DAC: Data Access Control
The TOE must provide each authorized user with the means of controlling and limiting access to the objects and resources it owns or for which it is responsible, on the basis of user identity or role and in accordance with the P.Protection_Mechanisms Security Policy.

***Coverage Rationale*:** O.DAC (Data Access Control) is provided by a combination of requirements. FDP_ACF.1 (Security attribute based access control) set the basic access rule through the Data Access Control Security Function Policy (P.DAC). FDP_ACC.1 (Subset access control) provides the definition of to whom these apply, while FIA_ATD.1 (User attribute definition) provides the list of user security attributes. Import and export of user data are controlled through FDP_ITC.1 (Import of user data with security attributes) and FDP_ETC.1 (Export of user data with security attributes). The requirement FIA_UID.2 (User identification before any action) ensures that users identify themselves before any action will be allowed by the TSF, while FIA_UAU.1 (Timing of authentication) covers when authentication is necessary. FIA_UAU.6 (Re-authenticating) requires re-authentication of the user before actions for which the user can be held legally responsible or during periods of inactivity. FMT_MOF.1 (Management of security functions behavior), FMT_MSA.1 (Management of security attributes), and FMT_MTD.1 (Management of TSF data) allow the management of these functions. FMT_MSA.2, FMT_MSA.3, FMT_MTD.2, and FMT_MTD.3 guarantee that only secure values of attributes and TSF data are used. Finally, FMT_REV.1 (Revocation) identifies the roles that are allowed to revoke the security attributes necessary to have access.

O.D_Read: Data Read Format
The TOE shall format data passing between modules on the IC such that information is not exposed.

***Coverage Rationale*:** O.D_Read (Data Read Format) is provided by FDP_ITT.1 (Basic internal transfer protection). This requirement provides the means of preventing the disclosure or modification of user data when they are transmitted between parts of the TOE according to policies expressed in the P.DAC and the P.IFC. FPT_ITT.1 (Basic internal TSF data transfer protection) further protects TSF data from modification.

O.Data_Exchange_Conf: Enforce Data Exchange Confidentiality
Protect user data confidentiality when exchanging data with a remote system.

***Coverage Rationale*:** O.Data_Exchange_Conf (Enforce data exchange confidentiality) is provided by FDP_ITC.1 (Import of user data with security attributes) and FDP_ETC.1 (Export of user data with security attributes), which controls the import and export of user data.

O.Env_Strs: Environmental Stress
The TOE must protect itself against compromise by having a structure that neither reveals security information nor operates in an insecure fashion when exposed to out-of-standard conditions (high or low) in the environment, including such factors as temperature, voltage, clock frequency, and external energy fields.

***Coverage Rationale*:** O.Env_Strs (Environmental stress) is provided by FPT_PHP.3 (Resistance to physical attack) and FPT_FLS.1 (Failure with preservation of secure state). These requirements protect against identified vulnerabilities, including those that deal with manipulations outside defined operational boundaries and preserves a secure state of operation in the event that a failure does occur. This objective is ensured by AVA_VLA.3 (Moderately resistant).

O.Fail_Secure: Preservation of Secure State for Failures in Critical Components
Preserve the secure state of the system in the event of a secure component failure.

***Coverage Rationale*:** O.Fail_Secure (Preservation of secure state for failures in critical components) is provided by FPT_PHP.3 (Resistance to physical attack) and FPT_FLS.1 (Failure with preservation of secure state). The definition of a "secure state" should be provided by the security model documentation (ADV_SPM.1). These requirements protect against identified vulnerabilities, including those that deal with manipulations outside defined operational boundaries, and preserve a secure state of operation in the event that a failure does occur. This objective is ensured by AVA_VLA.3 (Moderately resistant).

O.I_Leak: Information Leak
The TOE must provide the means of controlling and limiting the leakage of information in the TOE so that no useful information is revealed over the power, ground, clock, reset, or I/O lines.

***Coverage Rationale*:** O.I_Leak (Information Leak) is provided by FDP_ITT.1 (Basic internal transfer protection). This requirement provides the means of preventing the disclosure or modification of user data when they are transmitted between parts of the TOE according to policies expressed in the P.DAC and the P.IFC. FPT-ITT.1 further protects TSF data from disclosure. FDP-IFF.3 (Limited illicit information flows) limits covert information flows as defined in FDP-IFC.1 (Subset information flow control).

O.Init: Initialization
An initialized TOE not in the Totally Locked state must assume the Nonauthenticated state immediately upon power-up, reset, or after other restart conditions.

***Coverage Rationale*:** By FIA_UID.2, the user will be identified before any actions are performed, which occurs in the Nonauthenticated state. By FPT_RCV.4 (Function recovery), upon reset or other restart condition, the TOE enters the secure Power-on state and from there, it enters the Nonauthenticated state.

O.Input_Probe: Probing by Selected Inputs
The TOE must be resistant to repeated probing through insertion of erroneous data.

***Coverage Rationale*:** O.Input_Probe (Probing by selected inputs) is provided by FPT_PHP.3 (Resistance to physical attack). This requirement protects against identified vulnerabilities, including those that deal with manipulations outside defined operational boundaries. FDP_DAU.1 (Basic data authentication) provides protection against using inserted erroneous data.

O.Key_Encrypt: Encryption of Stored Keys (TSRD)
Keys stored in nonvolatile memory on the TOE must be encrypted.

***Coverage Rationale*:** O.Key_Encrypt (Encryption of stored keys) is provided by FCS_CKM.3 (Cryptographic key access). This requirement ensures that access to cryptographic keys is in accordance with a specified access method and based on an assigned standard.

O.Life_Cycle: Life-Cycle Functions
The TOE must provide a means of controlling and limiting the use of life-cycle-specific commands to the life-cycle stages in which they are intended.

***Coverage Rationale*:** O.Life_Cycle (Life-cycle functions) is provided by FDP_ACF.1 (Security-attribute based access control), which sets the basic access rules through the P.DAC and FDP_ACC.1 (Subset access control), which provide the definition of to whom these apply.

O.Log_Prot: Logical Protection
The TOE must protect itself against logical compromise by having a structure that is resistant to logical manipulation or modification.

Implementation Application: Updated versions of the TOE should counter vulnerabilities discovered in previous TOE versions.

***Coverage Rationale*:** O.Log_Prot (Logical Protection) is provided by the requirements and assurances discussed below. FPT_PHP.1 (Passive detection of physical attack) and FPT_PHP.3 (Resistance to physical attack) detect and protect against identified vulnerabilities, including those that deal with manipulations outside defined operational boundaries. FPT_FLS.1 (Failure with preservation of secure state) preserves a secure state of operation in the event that a failure does occur. FPT-SEP.1 (TSF domain separation) and FPT-REV.1 (Non-bypassability of the TSP) ensure that the TSP is always invoked and that the TSF is protected from modification or damage by providing domain separation required for TSF execution. This objective is further supported by ADV_IMP.1 (Subset of the implementation of the TSF), specifically in the implementation of unique serial number and other life-cycle identifiers. This objective is further ensured by AVA_VLA.3 (Moderately resistant), which reviews the identified vulnerabilities, including those involving the deconstruction and manipulation of the IC.

O.Mult_App: Multiple Applications
The TOE must support an application (or applications) while providing and maintaining security between and among the various resident elements.

Coverage Rationale: By FDP_IFF.1, all application-specific data are identified with that application. By FDP_ACC.1, these data are only available to that application and by FDP_IFC.1, an application defines which other applications can have access to its application-specific information.

O.Phys_Prot: Physical Protection
The TOE must be resistant to physical attack or be able to create difficulties in understanding the information derived from such an attack.

Coverage Rationale: By FPT_PHP.1, the TOE will detect physical tampering. By FPT_PHP.3, the TOE will automatically enter the Totally Locked state to prevent violation of the TOE Security Policy due to physical tampering. By FDP_DAU.1, DoD data are encrypted and will not be understandable.

O.Res_Access: Resource Access
The TOE shall protect its resources against monopolization by a user or attacker to the detriment of other users of the TOE.

Coverage Rationale: By FRU_RSA.1, the TOE enforces maximum quotas on memory, program space, and other resources on defined groups of users.

O.SSO_Data: Data Initialized by SSO
Only the SSO may set authentication, initial security, and personalization data.

Coverage Rationale: The policy for SSO access is established by P.DAC. FDP_ACC.1 specifies that the TOE will enforce P.DAC on the specified data. FDP_ACF.1 specifies that access is controlled by role, and that all access information is properly protected.

O.Secure_Host_Comms: Secure Host Communications
The TOE and the host shall establish a secure channel, using a session key composed of components created by the TOE and the host, before exchanging cryptographic or other DoD data.

Coverage Rationale: By FTP_ITC.1, all cryptographic and DoD data are exchanged by way of a trusted channel that is logically distinct from other communication paths and provides assured identification of its end points and protection of the communicated data from modification or disclosure. By FPT_ITI.1, any modification during transmission is detected. By FCS_CKM.1, the session key used for this exchange must be created by the TOE and the host. By FDP_UIT.1, DoD data can only be exchanged between a trusted host and the TOE by way of the channel, and the channel protects it from modification, deletion, insertion, and replay errors.

O.Self_Test: Self Test
Self-tests shall ensure the TOE is functioning properly. Integrity of all code on the TOE shall be checked. Cryptographic and other security-critical functions shall be tested. These tests shall be performed during power-up and under certain conditions.

Coverage Rationale: By FPT_TST.1, the TSF shall run a suite of self-tests during initial start-up, when power, input voltage, input frequency, or temperature are outside their normal range, or when requested by the user. By FPT_AMT.1, these tests demonstrate the correct operation of the TSF security assumptions.

O.Set_Up: Set-Up Sequence
The TOE shall require that the SSO updates the preset SSO verification data prior to entering the Nonauthenticated state or an Authenticated state.

Coverage Rationale: P.DAC only allows the Default SSO to update the SSO verification data. FDP_ACC.1 specifies that the TOE will enforce P.DAC on the specified data. FDP_ACF.1 specifies that access is controlled by role, and that all access information is properly protected.

O.Tamper_Response: Respond to Tamper
The TOE shall respond to physical tampering against specified system devices and components.

Coverage Rationale: By FPT_PHP.3, the TOE automatically responds to physical probing and manipulation such that the TSP is not violated. By FDP_RIP.1, the contents of all resources are made unavailable when the resources are deallocated by a reset or other restart condition.

O.Trial: Trial and Error Resistance
The TOE authentication mechanism is resistant to spoofing by trial and error.

Coverage Rationale: By FIA_SOS.1, authentication data for both users and SSOs are sufficiently long to prevent it from easily being guessed. By FIA_AFL.1, repeated wrong guesses cause the TOE to enter a locked state.

O.Unlink: Linkage
The TOE must provide the means of allowing an entity to make multiple uses of resources or services without other entities being able to link those uses together.

Coverage Rationale: P.DAC does not permit non-DoD users to access DoD directories that contain resource usage information. By FDP_ETC.1, this is enforced when data are exported from the TOE, and by FDP_ITT.1 it is enforced when data are transferred between different parts of the TOE. FDP_IFC.1 and FDP_IFF.1 guarantee that the P.Info_Flow_Control holds and that data, including resource usage, only flow between applications as allowed by those applications.

O.Volatile_Memory: Destruction of Volatile Memory
The contents of volatile memory cannot be retrieved after power is removed from the TOE or a failure occurs.

Coverage Rationale: By FPT_FLS.1, a lack of power or a failure requires that a secure state be preserved. Since there are no protections on volatile memory, the only way that it can be secure is to be zeroized.

6.3.2 Assurance Security Requirements Rationale

The assurance level for this protection profile is EAL4 augmented.

EAL4 allows a developer to attain a reasonably high assurance level without the need for highly specialized processes and practices. It is considered to be the highest level that could be applied to an existing token line without undue expense and complexity. As such, EAL4 is appropriate for the DoD PKI Token.

Evaluation Assurance Level (EAL) 4 is implemented in the TOE by:

1. ACM_AUT.1: Partial CM automation
2. ACM_CAP.4: Generation support and acceptance procedures
3. ACM_SCP.2: Problem tracking CM coverage
4. ADO_DEL.2: Detection of modification
5. ADO_IGS.1: Installation, generation, and start-up procedures
6. ADV_FSP.2: Fully defined external interfaces
7. ADV_HLD.2: Security enforcing high-level design
8. ADV_IMP.1: Subset of the implementation of the TSF
9. ADV_LLD.1: Descriptive low-level design
10. ADV_RCR.1: Informal correspondence demonstration
11. ADV_SPM.1: Informal TOE security policy model
12. AGD_ADM.1: Administrator guidance
13. AGD_USR.1: User guidance
14. ALC_DVS.1: Identification of security measures
15. ALC_LCD.1: Developer defined life-cycle model

16. ALC_TAT.1: Well-defined development tools
17. ATE_COV.2: Analysis of coverage
18. ATE_DPT.1: Testing: high-level design
19. ATE_FUN.1: Functional testing
20. ATE_IND.2: Independent testing—sample
21. AVA_MSU.2: Validation of analysis
22. AVA_SOF.1: Strength of TOE security function evaluation

Evaluation Assurance Level (EAL) 4 is augmented with:

1. ADV_CMM.1: Developer CMM Level 1
2. AVA_VLA.3: Moderately Resistant

Augmentation results from the selection of:

ADV_CMM.1 Development – Developer CMM Level 1

ADV_CMM.1 was created to address the threat of an attacker exploiting a development flaw in code used by the TOE. The Capability Maturity Model (CMM) for Software describes the key elements of an effective software process for a developer's organization. Following processes outlined by the CMM equips a developer to develop code that is less likely to contain flaws that can be exploited. ADV_CMM.1 provides assurance that the developer's organization has started preparing to meet the eventual DoD requirement of CMM Level 3. CMM Level 3 will provide assurance that code developed for the TOE does what it is designed to do.

AVA_VLA.3 Vulnerability Assessment—Vulnerability Analysis—Moderately resistant

The TOE is intended to function in a variety of applications, which may include secure messaging and identification systems. As such, it could contain, represent, or provide access to sensitive DoD data. In addition, the TOE will not always be directly under the control of trained and dedicated administrators. It may be subjected to a hostile environment for long periods of time. As a result, it is imperative that the TOE is shown to be moderately resistant to penetration attacks.

EAL4 requires vulnerability assessment through imposition of AVA_VLA.2. This dictates a review of only the identified vulnerabilities. Component AVA_VLA.3 requires, in addition, that a systematic search for vulnerabilities be documented and presented. This provides a significant increase in the consideration of vulnerabilities over that provided by AVA_VLA.2.

The rationale for this augmentation is based on the Common Evaluation Methodology (CEM) definitions of basic/medium/high attack potentials. These definitions apply most directly to information processing systems that exist in small numbers and that are offered some form of external protection. The TOE, as discussed above, may be issued in large quantities, is exposed for prolonged periods of time, and is subject to short duration secondary attacks based on longer term development of sophisticated capabilities. As a result, the attack potentials, as stated, are not appropriate. They need to be redefined in this context for the TOE described in this protection profile. With that understanding, a moderate attack potential would address the most reasonably expected competent attacks. Addressing all attacks at all levels (e.g., AVA_VLA.4) introduces cost and complexity higher than justified for all but the most secure applications. It is also questionable if, given the current CEM definitions, this level can be achieved.

AVA_VLA.3 has the following dependencies:

ADV_FSP.1	Informal functional specification
ADV_HLD.2	Security enforcing high-level design
ADV_IMP.1	Subset of the implementation of the TSF
ADV_LLD.1	Descriptive low-level design
AGD_ADM.1	Administrator guidance
AGD_USR.1	User guidance

All of these are met or exceeded in the EAL4 assurance package.

6.4 Dependency Rationale

This section demonstrates that the security requirements set forth in this PP form a mutually supportive and internally consistent whole. Internal consistency is shown through an analysis of dependencies. Mutual support is shown through consideration of the interactions between and among the security requirements.

The requirements in Table 6-5 are listed with requirements on which they are dependent. All of the dependencies identified below are met in this PP.

Table 6-5 Functional and Assurance Requirements Dependencies

Component	Depends On
Functional Requirements	
FCS_CKM.1	FCS_CKM.2 or FCS_COP.1, FCS_CKM.4, FMT_MSA.2
FCS_CKM.2	FCS_CKM.1, FCS_CKM.4, FMT_MSA.2
FCS_CKM.3	FCS_CKM.1, FCS_CKM.4, FMT_MSA.2
FCS_CKM.4	FCS_CKM.1, FMT_MSA.2
FCS_COP.1	FCS_CKM.1, FCS_CKM.4, FMT_MSA.2
FDP_ACC.1	FDP_ACF.1
FDP_ACF.1	FDP_ACC.1, FMT_MSA.3
FDP_DAU.1	-
FDP_ETC.1	FDP_IFC.1
FDP_IFC.1	FDP_IFF.1
FDP_IFF.1	FDP_IFC.1, FMT_MSA.3
FDP_IFF.3	FDP_IFC.1, AVA_CCA.1
FDP_ITC.1	FDP_IFC.1, FMT_MSA.3
FDP_ITT.1	FDP_IFC.1
FDP_RIP.1	-
FDP_UIT.1	FDP_IFC.1, FTP_ITC.1
FIA_AFL.1	FIA_UAU.1
FIA_ATD.1	-
FIA_SOS.1	-
FIA_UAU.1	FIA_UID.1
FIA_UAU.6	-
FIA_UAU.7	FIA_UAU.1
FIA_UID.2	-
FMT_MOF.1	FMT_SMR.1
FMT_MSA.1	FDP_ACC.1, FMT_SMR.1
FMT_MSA.2	FDP_ACC.1 or FDP_IFC.1, FMT_MSA.1, FMT_SMR.1, ADV_SPM.1
FMT_MSA.3	FMT_MSA.1, FMT_SMR.1
FMT_MTD.1	FMT_SMR.1
FMT_MTD.2	FMT_MTD.1, FMT_SMR.1
FMT_MTD.3	FMT_MTD.1, ADV_SPM.1
FMT_REV.1	FMT_SMR.1
FMT_SMR.1	FIA_UID.1
FMT_SMR.3	FMT_SMR.1
FPT_AMT.1	-
FPT_FLS.1	ADV_SPM.1
FPT_ITI.1	-
FPT_ITT.1	-
FPT_PHP.1	FMT_MOF.1
FPT_PHP.3	-
FPT_RCV.4	ADV_SPM.1
FPT_RVM.1	-

Component	Depends On
Functional Requirements	
FPT_SEP.1	-
FPT_TST.1	FPT_AMT.1
FRU_RSA.1	-
FTP_ITC.1	-
Assurance Requirements	
ACM_AUT.1	ACM_CAP.3
ACM_CAP.4	ACM_SCP.1, ALC_DVS.1
ACM_SCP.2	ACM_CAP.3
ADO_DEL.2	ACM_CAP.3
ADO_IGS.1	AGD_ADM.1
ADV_FSP.2	ADV_RCR.1
ADV_HLD.2	ADV_FSP.1, ADV_RCR.1
ADV_IMP.1	ADV_LLD.1, ADV_RCR.1, ALC_TAT.1
ADV_LLD.1	ADV_HLD.2, ADV_RCR.1
ADV_SPM.1	ADV_FSP.1
AGD_ADM.1	ADV_FSP.1
AGD_USR.1	ADV_FSP.1
ALC_TAT.1	ADV_IMP.1
ATE_COV.2	ADV_FSP.1, ATE_FUN.1
ATE_DPT.1	ADV_HLD.1, ATE_FUN.1
ATE_IND.2	ADV_FSP.1, AGD_ADM.1, AGD_USR.1, ATE_FUN.1
AVA_MSU.2	ADO_IGS.1, ADV_FSP.1, AGD_ADM.1, AGD_USR.1
AVA_SOF.1	ADV_FSP.1, ADV_HLD.1
AVA_VLA.3	ADV_FSP.1, ADV_HLD.2, ADV_IMP.1, ADV_LLD.1, AGD_ADM.1, AGD_USR.1

6.5 Strength of Function Rationale

The strength of function rating of SOF-medium is based on the potentially high value of information protected by the TOE, as well as the level of threat to the TOE as described in section 3.2 of this PP. Medium is specified to counter the assumption that attackers have a medium level of expertise, resources, and motivation. This strength of function rating is in turn consistent with the security objectives described in section 4.

Appendix A: References

[1] Common Criteria, Version 2.1, International Standard 15408, http://www.csrc.nist.gov/cc, August 1999.

[2] Department of Defense Chief Information Officer Guidance and Policy Memorandum 6-8510. *Department of Defense Information Assurance.* Draft, January 2000.

[3] International Standards Organization. ISO 7816 - I*dentification Cards - Integrated Circuit Cards with Contacts*.

[4] Kocher, Paul. "Differential Power Analysis and Problems in Applied Cryptography." In *CardTech/SecurTech '99 Gateway to Practical Innovation*. Chicago, 1999.

[5] National Institute of Standards and Technology. FIPS 140-2. *Security Requirements for Cryptographic Modules*. (Draft) 1999.

[6] National Security Agency. The Information Assurance Technical Framework, Release 2.0.1, September 1999. http://www.iatf.net/.

[7] *Smart Card Security User Group Smart Card Protection Profile*, Draft Version 2.0 May 1, 2000.

[8] U. S. Department of Defense. *Consideration of Smart Cards as the DoD PKI Authentication Device Carrier*, 10 January 2000.

[9] U. S. Department of Defense. *DoD Target Token Requirements Document*, (Draft), 8 March 2000.

[10] U. S. Department of Defense. *Public Key Infrastructure Target Class 4 Token Security Requirements*, Draft version 1.01, April 10, 2000.

[11] U. S. Department of Defense. *X.509 Certificate Policy for the United States Department of Defense*, version 5.2, 13 November 2000.

Appendix B: Acronyms

Common Criteria-Related Acronyms

CC	Common Criteria
CEM	Common Evaluation Methodology
EAL	Evaluation Assurance Level
ISO	International Standards Organization
IT	Information Technology
PP	Protection Profile
SCSUG	Smart Card Security User Group
SF	Security Function
SFP	Security Function Policy
SML	Strength of Mechanism Level
SOF	Strength of Function
ST	Security Target
TOE	Target of Evaluation
TSC	TSF Scope of Control
TSF	TOE Security Functions
TSFI	TSF Interface
TSP	TOE Security Policy

Token-Related Acronyms

CAD	Card Acceptor Device
CM	Configuration Management
CSP	Cryptographic Security Parameter
DPA	Differential Power Analysis
EEPROM	Electrically Erasable Programmable Read Only Memory
IC	Integrated Circuit
ICC	Integrated Circuit Card
ISO	Information Security Officer
PIN	Personal Identification Number
RAM	Random Access Memory
ROM	Read Only Memory
RSA	Rivest, Shamir, and Adleman (encryption algorithm)
SBU	Sensitive But Unclassified
SFP	Security Function Policy
SIM	Subscriber Identity Module
SPA	Simple Power Analysis
SSO	System Security Officer
UA	Unauthorized Agent

Appendix C: Glossary of Terms

The Glossary of Terms is subdivided into two sections: Common Criteria Terminology and Token Terminology.

Common Criteria Terminology

This section contains terms that are used in a specialized way in the CC. The majority of terms in the CC are used either according to their accepted dictionary definitions or commonly accepted definitions found in ISO security glossaries or other well-known collections of security.

Administration Administrative responsibilities will be split between a system administrator and a security administrator who together will be able to administer the entire system. This is done to prevent any one person having too much control and to provide for two person integrity (checks and balances).

Assets Information or resources to be protected by the countermeasures of a TOE (e.g., user data and cryptographic keys).

Assignment The specification of an identified parameter in a component.

Assurance Ground for confidence that an entity meets its security objective.

Attack potential The perceived potential for success of an attack, should an attack be launched, expressed in terms of an attacker's expertise, resources, and motivation.

Augmentation The addition of one or more assurance component(s) from Common Criteria Part 3 to an EAL or assurance package.

Authorized user A user who may, in accordance with the TSP, perform an operation.

Component The smallest selectable set of elements that may be included in a PP, an ST, or a package.

Dependency A relationship between requirements such that the requirement that is depended upon must normally be satisfied for the other requirements to be able to meet their objectives.

Element	Most detailed refinement of a CC functional requirement. Similar elements when grouped together form a CC component requirement. When a CC component functional requirement is included in a PP, all associated elements must be included.
Evaluation Assurance Level (EAL)	A collection of assurance components from CC, Part 3, which when selected, represents a point on the CC predefined assurance scale.
Extension	The addition to an ST or PP of functional requirements not contained in CC, Part 2 and/or assurance requirements not contained in Part 3 of the CC.
Identity	A representation (e.g., a string) uniquely identifying an authorized user that can be either the full or abbreviated name of that user or a pseudonym.
Information	Defined as user data, regardless of its format.
Information Security Officer (ISO)	A person responsible for creating, maintaining, interpreting, and overseeing consistent implementation of site security policy and procedures.
Internal Communication Channel	A communication channel between separated parts of the TOE.
Internal TOE transfer	Communicating data between separated parts of the TOE.
Object	An entity within the TSC that contains or receives information and on which subjects perform operations.
Organizational Security Policies	One or more security rules, procedures, practices, or guidelines imposed by an organization upon its operations.
Protection Profile (PP)	An implementation-independent set of security functional and assurance requirements for a category of TOEs that meet specific consumer needs.
Refinement	The addition of details to a component.
Resources	Any system asset required for the correct operation of the TOE.
Role	A predefined set of rules establishing the allowed interactions between a user and the TOE.

Secret	Information that must be known only to authorized users and/or the TSF in order to enforce a specific SFP.
Security attribute	Information associated with subjects, users, and/or objects that is used for the enforcement of the TSP.
Security Function (SF)	A part or parts of the TOE that have to be relied on for enforcing a closely related subset of the rules from the TSP.
Security Function Policy	The security policy enforced by part or parts of the TOE that have to be relied upon for enforcing a closely related subset of rules from the TSP.
Security objective	A statement of intent to counter identified threats and/or satisfy identified organizational security policies and assumptions.
Security Target (ST)	A set of security requirements and specifications to be used as the basis for evaluation of an identified TOE.
Selection	The specification of one or more items from a list in a component.
Strength of Function (SOF)	A qualification of a TSF expressing the minimum efforts assumed necessary to defeat its expected security behavior by directly attacking its underlying security mechanisms.
SOF-basic	A level of the TOE strength of function in which analysis shows that the function provides adequate protection against casual breach of TOE security by attackers possessing a low attack potential.
SOF-medium	A level of the TOE strength of function where analysis shows that the function provides adequate protection against straightforward or intentional breach of TOE security by attackers possessing a moderate attack potential.
SOF-high	A level of the TOE strength of function where analysis shows that the function provides adequate protection against deliberately planned or organized breach of TOE security by attackers possessing a high attack potential.
Strength of Mechanism Level (SML)	A scale for measuring the relative strength of a security mechanism hierarchically ordered from SML 1 through SML 3.
Subject	An entity within the TSC that causes operations to be performed.
Target of Evaluation	An IT product or system and its associated administrator and user

(TOE)	guidance documentation that is the subject of evaluation.
TOE Security Functions (TSF)	A set consisting of all hardware, software, and firmware of the TOE that must be relied on for the correct enforcement of the TSP.
TOE Security Functions Interface (TSFI)	A set of interfaces, whether interactive (man-machine interface) or programmatic (application programming interface), through which TOE resources are accessed and mediated by the TSF, or information is obtained from the TSF.
TOE Security Policy (TSP)	A set of rules that regulate how assets are managed, protected, and distributed within a TOE.
TOE Security Policy Model	A structured representation of the security policy to be enforced by the TOE.
TSF data	Data created by and for the TOE that might affect the operations of the TOE.
TSF Scope of Control (TSC)	The set of interactions that can occur with or within a TOE and are subject to the rules of the TOE site security policy.
Trusted Channel	A means by which a TSF and a remote trusted IT product can communicate with necessary confidence to support the TSP.
Unauthorized Agent (UA)	Any person (or process acting on behalf of a person) that is not authorized, under the TOE site security policy, to access the TOE resources or information processed by the TOE. This person includes anyone from a “hacker” to a determined foreign adversary, and security administrators, system administrators or authorized users who are untrustworthy.
User	Any entity (human user or external IT entity) outside the TOE that interacts with the TOE.
User data	Data created by and for the user that does not affect the operation of the TSF.

Token Terminology

This section contains terms that are used in a specialized way in the token authentication device industry. The majority of terms are used either according to their accepted dictionary definitions or commonly accepted definitions found in ISO security glossaries or other well-known collections of security.

Access control Process of granting access to information system resources only to authorized users, programs, processes, or other systems.

Application (1) An application may also be called an Executable file, Applet, or Cardlet (for Java Cards). An application is to be run on the token that may be downloaded onto the token during enrollment, or just prior to execution invoked by the host.
(2) Intended final use for the token. This may include (but is not limited to) such activities as payment, telephony, identification, secure information storage, or access.

Attack An attempt to gain unauthorized access to an information system's services, resources, or information or the attempt to compromise an information system's integrity, availability, or confidentiality. There are several forms of attacks including:
- **Malicious attacks –** virus, worm, Trojan horse, masquerading
- **Unintentional attacks –** malfunction, human error
- **Physical attacks –** fire, water, battle damage, power loss

Biometrics Automated methods of authenticating or verifying an individual based on a physical or behavioral characteristic.

Cell Family The group of building blocks used in the fabrication of any IC. A custom-made cell family will hinder the attacker attempting the reverse engineering of a token.

Cryptographic module The set of hardware, software, firmware, or some combination thereof that implements cryptographic logic processes, including cryptographic algorithms, and is contained within the cryptographic boundary of the module.

Cryptographic Security Parameter (CSP) Security-related information (e.g., secret and private cryptographic keys and authentication data such as biometrics, passwords, PINs) appearing in plain text or otherwise unprotected form and whose disclosure or modification can compromise the security of a cryptographic module or the security of the information protected by the module.

Differential Power Analysis (DPA)	A technique combining physical measurement of such things as power consumption with statistical signal processing techniques to identify IC operating details. DPA can, in some instances, provide information leading to recovery of internal operational parameters, keys, etc.
DoD data	All data on the TOE located below the DoD directory. These data are owned by DoD. It includes DoD executables, DoD PINs, DoD cryptographic keys, and DoD user personal information.
Electrically Erasable Programmable Read Only Memory (EEPROM)	A non-volatile memory technology where data can be electrically erased and rewritten.
Failure analysis	The compilation of techniques used by semiconductor development and testing labs to identify the operating problems in newly designed or modified ICs. Such techniques include not only observation (to determine what is not functioning properly) but also modification of IC internal structure (to determine fixes).
Host	Device to which a token authenticates to establish a secure communication path.
Integrated Circuit (IC)	Electronic component(s) designed to perform processing and/or memory functions contained on a single chip.
Integrated Circuit Card (ICC)	A card into which has been inserted one or more ICs.
Initialization	The process of writing specific information into nonvolatile memory during IC manufacturing and testing as well as executing security protection procedures by the IC manufacturer.
Key Exchange Algorithm (KEA)	Algorithm used by cryptoprocessors (e.g., FORTEZZA®) to produce key exchange keys. See the following Web site for more details: http://csrc.nist.gov/encryption/skipjack/skipjack-kea.htm .
Nonvolatile memory	A semiconductor memory that retains its content when power is removed (i.e., ROM, EEPROM, FLASH).
Operational keys	The cryptographic keys loaded onto the assembled token product for use by the token holder during normal operations.
Password	A string of characters (letters, numbers, and other symbols) used to authenticate an identity or verify access authorization.

Personal Identification Number (PIN)	A 4- to 12- character alphanumeric code or password used to authenticate an identity (commonly used in banking applications).
Personalization	The process of writing specific information into the nonvolatile memory preparing the IC for issuance to users.
Photomask	A mask used during chip manufacturing to protect selected parts of a silicon wafer from a light source while allowing other parts of the surface of the wafer to be exposed. The purpose is to expose the photoresist on the surface so that subsequent etching processes can generate the desired substrate structure. The photomask is the means by which the chip's circuits and, therefore, its functionality are placed on the chip.
Post-issuance	The time period during which the token is in the hands of the user. On some tokens, additional functionality can be loaded onto the token post-issuance.
Private key	A cryptographic key used with a public key cryptographic algorithm, uniquely associated with an entity and not made public.
Public key	A cryptographic key used with a public key cryptographic algorithm, uniquely associated with an entity, and that may be made public.
Public key (asymmetric) cryptographic algorithm	A cryptographic algorithm that uses two related keys for encryption and decryption—a public key and a private key. The two keys have the property that, given the public key, it is computationally infeasible to derive the private key.
Production Keys	The cryptographic keys loaded onto the IC for security during production.
Random Access Memory (RAM)	A volatile, randomly accessible memory (used in the IC) that requires power to maintain data.
Read Only Memory (ROM)	A nonvolatile memory (used in the IC) that requires no power to maintain. ROM data are often contained in one of the numerous masks used during manufacture.
Reverse engineering	The compilation of techniques used by semiconductor development and testing labs to generate design documentation and specifications for an unknown IC. Reverse engineering, in its most complete sense, would allow the identification of a complete

	fabrication package given only an (unidentified) IC as a starting point.
Simple Power Analysis (SPA)	A technique in which physical measurements of power consumption over time are used to identify IC operating details. SPA can, in some instances, provide information leading to recovery of internal operational parameters, keys, etc.
Subscriber Identification Module (SIM)	A token having a shape in accordance with ISO 7812, designed to be inserted into a special cavity in a mobile phone.
System Security Officer (SSO)	The role assumed to perform a set of cryptographic initialization or management functions (e.g., cryptographic key and parameter entry, and alarm resetting).
Tamper detection	The automatic determination by a cryptographic module that an attempt has been made to compromise its physical security.
Tamper response	The automatic action taken by a cryptographic module when it detects that a physical tampering has occurred (minimum response action is zeroization of plain text keys and other CSPs).
Terminal	The device capable of reading or writing to a token.
Token	An authentication device carrier that is used to store and carry cryptographic keys and certificates supporting user identity authentication. This technology can consist of (but is not limited to) smart cards, USB tokens, PCMCIA Card, and iButtons® /JavaRing® technology.
Token holder	A person to whom a token has been legitimately issued (a user).
Token issuer	An institution who issues tokens.
Token Operating System	Operating system developer-specific code, written in the microprocessor's native or machine code.
Token reader	A machine capable of reading and/or writing to a token.
Transport keys	The cryptographic keys loaded onto the IC for security during transport of ICs, modules, and assembled products prior to issuance.
Zeroization	A method of erasing electronically stored data by altering or deleting the contents of the data storage so as to prevent the recovery of the data.

Appendix D: Description of Token States

Some states of the DoD PKI Token need to be defined to effectively describe the conditions under which some of the token security requirements apply. The following diagram, Figure D-1, illustrates the states of the token and the relationships between the states.

Security critical functions will only be executable in the appropriate authentication state. Each description of a state will contain a list of allowable host-commanded functions (functions that the host commands the token to perform). If a given function is listed under a given state, then it cannot be run under any other state unless it is explicitly stated.

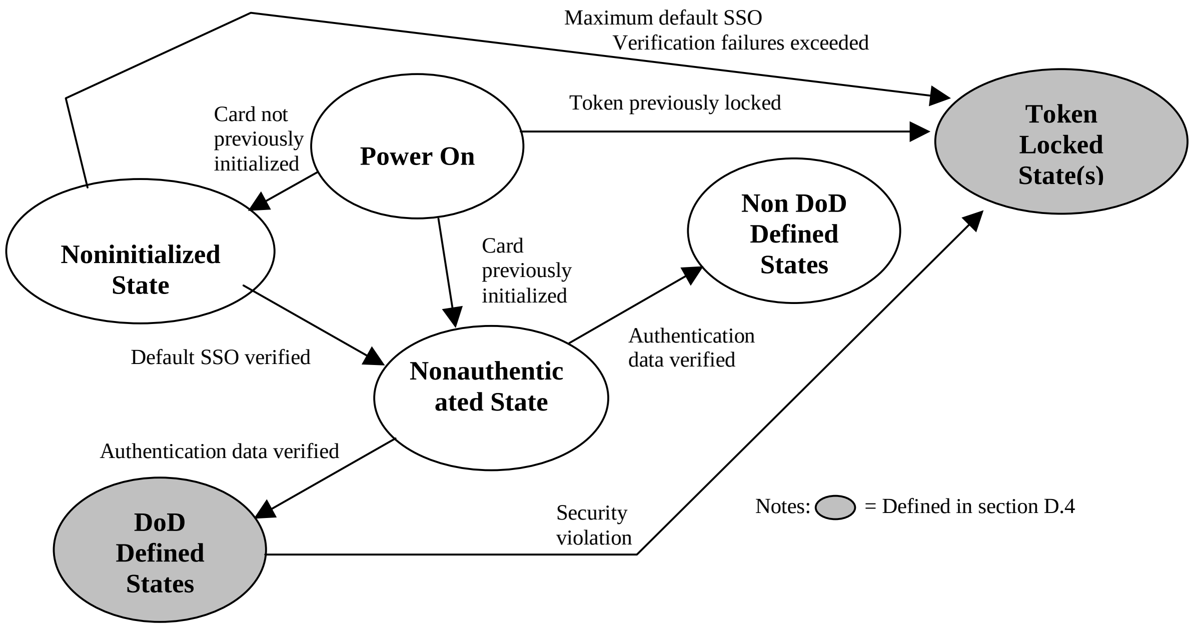


Figure D-1 Token Top Level State Diagram

D.1 Power-On State

The Power-On state will perform required power on tests and determine the next state. Out-of-range temperatures and power and faulty clock signals will place the TOE in the Power-On state. The following requirements apply to the Power-On state:

1. The token must determine if the token has been previously initialized or locked.
2. If the token has been locked, then the specific locked state must be entered (refer to section D.4.3 for a description of locked states).
3. If the token has not been locked, and if the token has not been initialized, then the Noninitialized state must be entered.
4. If the token has not been locked, and if the token has been initialized, then the Nonauthenticated state must be entered.
5. Power-on self-tests (in compliance with FIPS 140-2 Level 2 for Subscribers/Level 3 for Registration Authorities and Certificate Authorities) must be run prior to exiting the power-on state.
6. Self-tests must include data integrity on all code and tests on cryptographic functions and all security-critical functions.

Host commanded functions allowed in this state:
- None.

D.2 Noninitialized State

The Noninitialized state is the state of the token after manufacture. The following requirements apply to the Noninitialized State:

1. The Noninitialized state will implement default SSO verification data.
2. Updating the SSO verification data is the only token function allowed in this state.
3. Upon receiving the token, the token issuer must update the SSO verification data.
4. Updating the SSO data must include verification of the default data. Four successive verification failures will place the token in the Totally Locked state (refer to section D.4.3.3 for details).
5. Successfully updating the SSO data will result in placing the token in the Nonauthenticated state.
6. The default SSO data must be destroyed (i.e., the Noninitialized state must never be used again).

Host commanded functions allowed in this state:
- Update of the SSO's authentication data.

D.3 Nonauthenticated State

This is the state of the token after power-on and a successful SSO update. The following requirements apply to the token in the Nonauthenticated state:

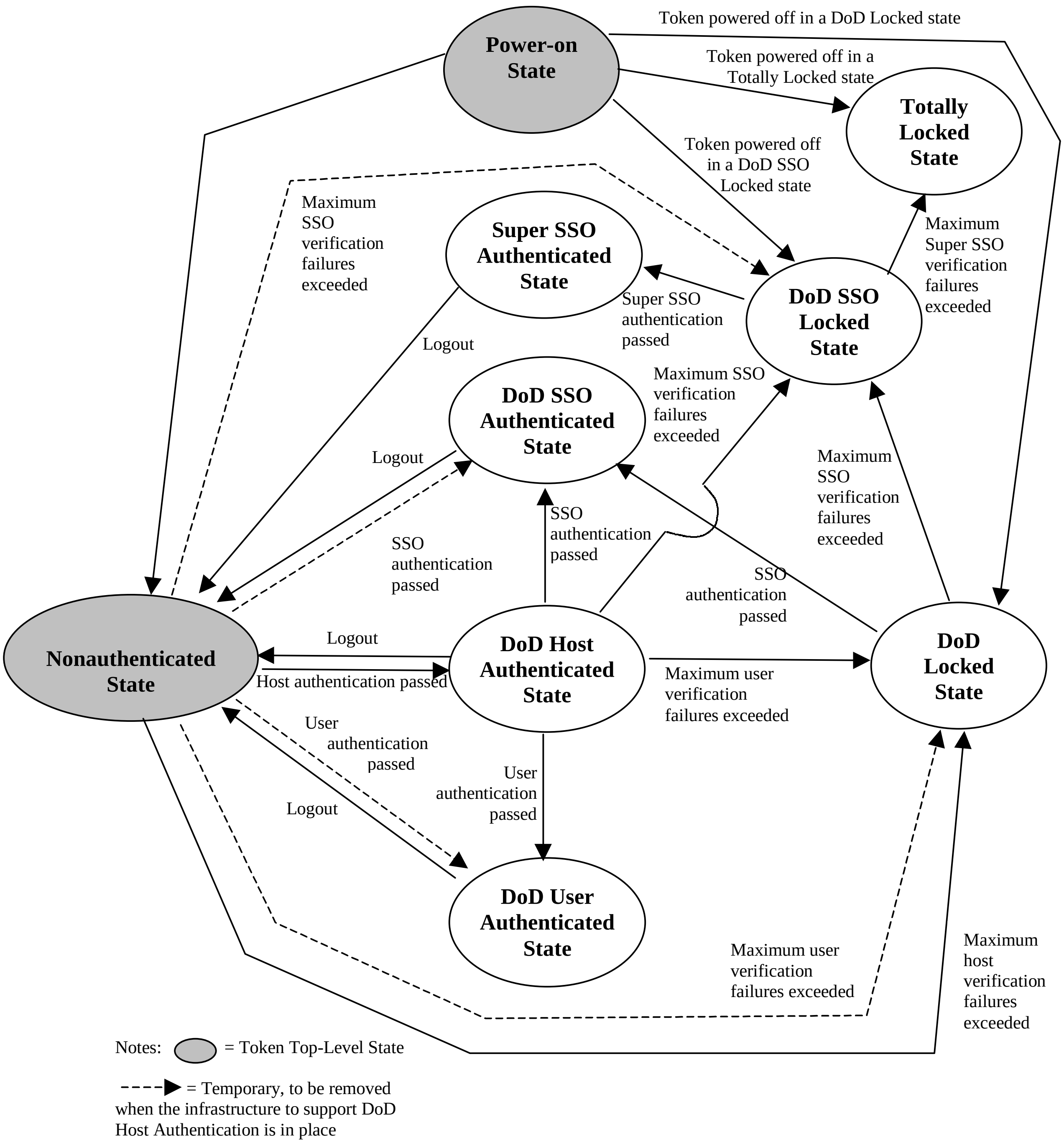
1. The Nonauthenticated state will enter a Token Locked state if any security violation (e.g., a PIN or biometric verification attempt exceeding the maximum number of attempts allowed) occurs.
2. The Nonauthenticated state shall only be exited when an authentication mechanism has been successful or a security violation has occurred.

Host commanded functions that are allowed in this state:
- General status information about the token.
- Directory or file information about non-DoD directories, if the application that owns the directory allows it (e.g., the electronic purse).
- Functions that do not have a requirement to operate in an Authenticated state.

D.4 DoD Defined States

This section defines token states specific to DoD security requirements. Figure D-2 below illustrates the relationships between the Token Top Level states (Figure D-1) and DoD specific states.

Figure D-2 DoD Level State Diagram



D.4.1 DoD Authentication States

The token will require several authentication states.

The following requirements pertain to achieving these states:

1. The directory owner may determine how the user-authenticated state is achieved.
2. All non-DoD applications (e.g., electronic commerce) run in a nonauthenticated state (the states of those applications are not trusted).

Access control for the DoD directories on the DoD PKI token is based on establishing roles that require an authentication method to place the token in an authenticated state. The following diagram illustrates the relationship between the user, the authentication method, and the state(s). The states for which authentication is necessary prior to entry are the DoD Host Authenticated state and the DoD Human Authenticated states consisting of the DoD SSO Authenticated state, DoD Super SSO Authenticated state, and the DoD User Human Authenticated state.

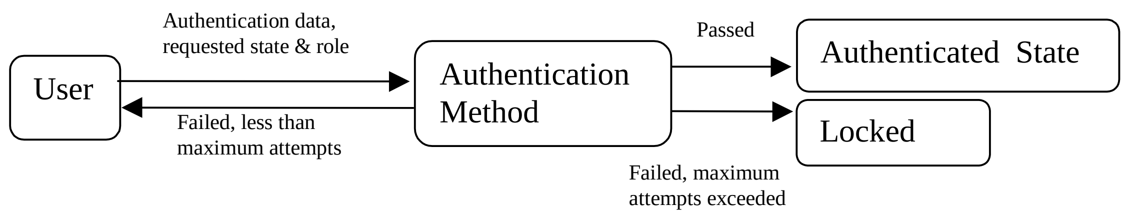


Figure D-3 Role Between User, Authentication Method, and Authenticated State

D.4.1.1 DoD Host Authenticated State

The DoD Host Authenticated state exists when the DoD Host Access Method has been successfully completed. The DoD Host Authenticated state is intended to provide a state in which trust can be placed in the host communicating with the token. Once the host has been authenticated with the token and a secure session has been established, then a state will exist in the token in which the token is protected from many host-based attacks.

The User Authenticated state can be accessed from within the Host Authenticated state. If infrastructure exists to support the DoD Host Access Method, then the User state should only be accessed from the Host Authenticated state.

Host commanded functions that are allowed in this state:

- Directory or file information about DoD directories
- Access to certificates
- Access to the DoD Human Authenticated states

The User Authenticated state can be accessed from within the Host Authenticated state. If infrastructure exists to support the DoD Host Access Method, then the User state should only be accessed from the Host Authenticated state.

Host commanded functions that are allowed in this state:
- Directory or file information about DoD directories
- Access to certificates
- Access to the DoD Human Authenticated states

D.4.2 DoD Human Authenticated States

The DoD Human Authenticated states are the DoD SSO Authenticated state or the DoD User Authenticated state.

Host commanded functions that are allowed in these states:
- Generating private/public key pairs
- Loading private keys
- Loading certificates
- Loading EXFs
- Creating directories or files within the Master File (the top level directory)
- Creating directories or files under the DoD directory

D.4.2.1 DoD SSO Authenticated State

The SSO Authenticated state exists after an SSO has been authenticated using the SSO authentication mechanism.

Host commanded functions that are allowed in this state:
- Token intialization (updating the SSO authentication data from the default after manufacture)
- Unlocking the token after the Token Locked state has been entered
- Creating, modifying, and updating DoD user authentication data

D.4.2.2 DoD Super SSO Authenticated State

The Super SSO Authenticated state exists after a Super SSO has been authenticated using the established Super SSO authentication mechanism.

Host commanded functions that are allowed in this state:
- Token intialization (updating the SSO authentication data from the default after manufacture)
- Unlocking the token after the Token Locked state has been entered

D.4.2.3 DoD User Authenticated State

The User Authenticated state exists after a user has been authenticated using the established user authentication mechanism.

Host commanded functions that are allowed in this state:
- Signing data
- E-mail operations

D.4.2.4 Exiting a Human Authenticated State

Any Human Authenticated state will revert to the Nonauthenticated state if:

1. A logout command is received from the host.
2. A directory or file is accessed (selected by the host) that is not within the same directory or below the directory that was selected when the authentication mechansism was invoked.
3. The token is removed from the token reader.
4. Power down condition occurs.
5. The token is reset.

D.4.3 Locked States

The DoD token must employ several Locked states to allow for enabling and disabling access control to the token.

D.4.3.1 DoD Locked State

The DoD Locked state will disable the functions that require DoD user verification after security violation has occurred (e.g., a PIN or biometric verification attempt exceeded the maximum number of attempts allowed).

1. The token must have the ability to be forced into a Token Locked state via an authentication mechanism.
2. The token must have the ability to be forced into a Token Locked state from an EXF.

Host commanded functions that are allowed in this state:
- An attempt to get to the DoD SSO Authenticated state
- Functions that do not require DoD user privileges

D.4.3.2 DoD SSO Locked State

The DoD SSO Locked state will exist to disable the token's functionality after failed attempts are made to enter the DoD SSO Authentication state (e.g., a PIN or biometric verification attempt exceeded the maximum number of attempts allowed). The SSO Locked state inherits all the requirements of the Token Locked state. In addition to those requirements, the following requirements apply:

1. The token must have the ability to be forced into a DoD SSO Locked State via an SSO authentication mechanism.
2. The token must have the ability to be forced into the DoD SSO Locked State from an EXF.
3. The token must have a Super SSO verification mechanism. The Super SSO authentication data are to be held only by a single entity within the DoD.

Host commanded functions that are allowed in this state:
- DoD SSO authentication
- Functions that do not require DoD User or DoD SSO privileges

D.4.3.3 Totally Locked State

The Totally Locked state will exist to disable the token's functionality after failed attempts are made to enter the DoD SSO authentication state (e.g., a PIN or biometric verification attempt exceeding the maximum number of attempts allowed). The TOE will enter the Totally Locked state when tampering is detected. The Totally Locked state inherits all the requirements of the Token Locked state. In addition to those requirements, the following requirements apply:

1. The token must have the ability to be forced into a Totally Locked state via an SSO authentication mechanism.
2. The token must have the ability to be forced into the Totally Locked state from an EXF.
3. It shall not be possible to leave the Totally Locked state.
4. The only host commanded functionality allowed in the Totally Locked state is the verification of an SSO.

Host commanded functions that are allowed in this state:
- SSO authentication

D.5 Non-DoD States

Non-DoD applications will be able to define separate authentication states (via EXFs), or use existing states in the token’s operating system.

The security requirements relating the non-DoD states are:
1. Non-DoD authentication states will have no effect on DoD authentication states.
2. Non-DoD applications cannot use DoD authentication states.

Host commanded functions that are allowed in this state:
- Functions that are not required to operate in DoD authenticated states

D.6 Additional States

Applications (DoD and Non-DoD) will be able to define separate authentication states (via EXFs) that run on the token for access to the files within the application's directory.

Appendix E: Approved Cryptographic Algorithms

The following cryptographic algorithms are approved for use with the DoD PKI Token:

<u>Signature Algorithms:</u>
2048 bit RSA
DSA 1024 (SHA-1)
Elliptic Curve Digital Signature Algorithm 384

<u>Key Exchange Algorithms:</u>
2048 bit RSA
Diffie-Hellman 1024
KEA 1024

<u>Symmetric Algorithms:</u>
DES 64
Triple DES 128
Skipjack

Any other NIST-approved cryptographic algorithms.

Appendix F: DoD Specifications

The DoD PKI Token PP refers to two specifications that are to be determined:

- Application Specification
- Key Management and SSO Authentication Scheme Specification

The Application Specification will detail the requirements for developing non-DoD applications and the requirements for loading DoD applications. This specification may require the token platform developer to provide guidance to develop secure applications on the platform.

The Key Management Specification will detail the DoD PKI Token's key management requirements, procedures, and policies. This specification will discuss key loading based on guidance in the TSRD, section 5.3.4.3 – Key Loading. The private key generated and stored on the token must never leave the token. It should be unchangeable and stored in nonvolatile EEPROM. This specification will also detail the handling of the private key on the token. The initial application verification key should be stored in ROM, and subsequent application verification keys should be stored in EEPROM. The SSO Authentication Scheme will be a section in the Key Management Specification and will detail the method for entering the SSO role for the token. It is based on guidance in the TSRD.

Appendix G: Comparison to the SCSUG's PP

The table below illustrates how SCSUG PP threats were addressed in the DoD PKI Token PP. Many of the SCSUG PP's threats were included in the Token PP with some or no modification. Additional threats added to the Token PP to cover threats identified by the DoD are listed after the table.

Table G-1 Treatment of SCSUG Threats

SCSUG Threat	How Treated
T.P_Probe	Unchanged
T.P_Modify	Unchanged
T.E_Manip	Unchanged
T.Flt_Ins	Unchanged
T.Forcd_Rst	Changed to T.Forced_State_Change; covers state changes rather than reset
T.Inv_Inp	Unchanged
T.Load_Mal	Not included, covered by T.Bad_Load
T.Reuse	Not included, covered by T. Crypt_Attk and secondary threat to T.Hacker_Comm_Eavesdrop
T.Search	Not included, covered by T.Rep_Atk
T.UA_Load	Renamed T.UA_Use
T.Access	Covered by P.DAC
T.First_Use	Unchanged
T.Impers	Unchanged
T.App_Ftn	Unchanged
T.LC_Ftn	Unchanged
T.Res_Con	Unchanged
T.Crypt_Atk	Added cryptanalysis
T.I_Leak	Unchanged
T.Link	Unchanged
T.Env_Strs	Unchanged
T.Lnk_Att	Unchanged
T.Rep_Atk	Unchanged
T.Clon	Unchanged
T.Carrier_Tamper	Not included, covered by T.P_Modify
T.Priv	Added verbiage at the end, changed name to T.Privilege (due to mod)

New Token PP Threats

New threats added to cover threats identified in the *Token Security Requirements* document:

T.Bad_Load
T.Component_Fail
T.Developer_Flawed_Code
T.Disable Security
T.Fail_Secure
T.Hacker_Comm_Eavesdrop
T.Hacker_Social_Engineer
T.Spoof

New threat that covers a SCSUG PP assumption:
T.Power_Clock

Comparison of Requirements

Requirements listed in the DoD PKI Token PP that are not in the SCSUG PP:

FCS_CKM.2 — Cryptographic key distribution

Signature and session keys generated by the token need to be distributed.

FCS_CKM.4 — Cryptographic key destruction

Old keys must be destroyed. FCS_CKM.1 and FCS_CKM.2 are dependent on this.

FDP_DAU.1 — Basic data authentication

The integrity of stored data must be verified.

FDP_IFF.3 — Limited illicit information flows

Prevents leakage over input or output connections.

FIA_SOS.1 — Verification of secrets

Specifies the strength of authentication.

FIA_UID.2 — User identification before any action

Instead of FIA_UID.1. We require identification before performing any actions.

FMT_SMR.1 — Security roles

Defines security roles.

FMT_SMR.3 — Assuming roles

Assuming the SSO role on the TOE requires a request from the SSO.

FPT_AMT.1 — Abstract machine testing

Used for self-test.

FPT_PHP.1 — Passive detection of physical attack

Use of coatings, etc., that provide evidence of tampering.

ADV_.1 — Developer CMM Level 1

Created to satisfy requirement in the DoD paper entitled *Public Key Infrastructure Target Class 4 Token Security Requirements* (Draft version 1.01, April 10, 2000).

Requirements listed in the SCSUG PP that are not in the DoD PKI Token PP:

FAU_ARP.1 — Security alarms
The token will not respond to detection of potential security violations with an alarm. An audit list will not be generated based on activity on the TOE.

FAU_SAA.1 — Potential violation analysis
This is a dependency of FAU_ARP.1, which is also not included. The token will not apply a set of rules in monitoring audited events and indicate a potential security violation based on these rules.

FAU_SEL.1 — Selective audit
This requirement is not necessary. The TOE does not have audit requirements.

FPT_RCV.3 — Automated recovery without undue loss
This requirement is not necessary.

FPT_RPL.1 — Replay detection
This requirement is not necessary.

ADV_INT.1 — Modularity
SCSUG augmented EAL4 with this additional requirement. It is not necessary.

Appendix H: Threat Comparison

The table below compares the threats identified in the DoD paper entitled *Public Key Infrastructure Target Class 4 Token Security Requirements* (Draft version 1.01, April 10, 2000) to the threats in the DoD PKI Token PP. This table illustrates that the threats identified in the *Token Security Requirements* document have been reflected in the Token PP.

Table H-1 Threat Comparison Between TSRD and Token PP

TSRD Threat	Token PP Threat
Adversary finds token or steals token. Note: Most of the other threats assume this threat has been accomplished.	
Development/Implementation flaw allows circumvention of security mechanisms.	T.Developer_Flawed_Code T.Component_Fail T.App_Ftn
Unauthorized terminal requests sensitive information from token (adversary creates a bogus terminal).	T.Spoof
Unauthorized executable file on token violates security mechanisms.	T.Bad_Load T.Privilege
Authorized executable file on token violates security mechanisms.	T.Developer_Flawed_Code T.UA_Use
Adversary manipulates data on token.	T.UA_Use T.Forced_State_Change T.Crypt_Attk T.E_Manip T.Env_Stress T.Flt_Ins
Adversary attempts to physically extract data from the token or change data/code/hardware.	T.E_Manip T.P_Modify T.P_Probe T.Clon
Adversary uses electrical analysis to get information from the token.	T.P_Probe
Adversary places a tap on the cable between the host and the token (reader) that extracts sensitive data, or adversary replaces reader device with storage capability.	T.Hack_Comm_Eavesdrop T.I_Leak

Adversary attempts to use a stolen token.	T.Impers T.Hacker_Social_Engineer T.Rep_Atk
Adversary steals token user authentication data.	T.Hacker_Social_Engineer T.Hacker_Comm_Eavesdrop
Adversary steals card prior to initialization and attempts to create a token.	T.First_Use
Adversary attempts to steal private keys during a key initialization or update of the keys on the token.	T.P_Probe T.Hacker_Comm_Eavesdrop
Adversary exploits a failure of a security function on the token hardware or software.	T.Component_Fail T.Developer_Flawed_Code T.Env_Strs T.Fail_Secure
Adversary finds a method of successfully circumventing a security mechanism of the token.	T.Link T.Lnk_Att T.P_Modify T.Bad_Load T.Privilege
Adversary attempts to change a configuration file.	T.P_Modify T.Env_Strs T.E_Manip T.Flt_Ins

Appendix I: Smart Card Vulnerabilities

Vulnerabilities in smart cards exist at the physical level ("the silicon"), logical level ("card operating system"), and organizational level ("transport, initialization, and implementation"). Vulnerabilities associated with microprocessor-based smart cards are listed below.

Physical Level:

- The smart cards derive their power from external sources. As a result, security functions are not always active, which results in a lack of active fraud detection measures.
- Data could be read or inserted on the data bus on a chip using microscopic probes.
- The chip structure could be reverse engineered using scanning electron microscope (SEM).
- SEM could also be used to visualize voltages on the chip surface, which would then be used to thoroughly understand the functionality of the chip.
- Data on the smart cards could be read using superconducting quantum interference devices (SQDIS), electrical testing, and electron beam testing.
- Other attacks, such as UV or X-rays or high temperatures, could cause erasure of memory. However, erasure of selected bits is not allowed without disabling the card.
- Physical parameters available outside the chip could be used to spoof or tamper data on the EEPROM, RAM, or even ROM. Some of the attacks used in the industry include Differential Power Analysis (DPA), Simple Power Analysis (SPA), and radiation.
- Physical parameters could also be used to change program flow or change data on EEPROM, ROM, and even RAM. Some of the techniques used in the industry include glitching—inserting spikes on power, clock, reset, and I/O lines, and voltage manipulation.

Logical Level:

- Due to advances in the semiconductor industry, operating systems (OS) are evolving significantly. Hence, the secure OS today may be primitive in nearly a year.
- Availability of hidden or unspecified commands could cause the OS to expose unauthorized data.
- Incorrect implementation of commands could produce unexpected and unintended results.
- Inappropriate use of cryptography would result in insecure data on the card.
- Due to the lack of memory partitioning, the operating system must ensure that each application is separately protected.
- Use of static authentication, as opposed to dynamic authentication, does not provide security against card counterfeiting.
- Many times security is obtained by obscurity. For example, vendors may try to hide security holes by not revealing the test results or the architecture of their operating system.

Organizational Level:

- Systems and applications do not provide or use the functionality necessary to implement good security. For example, the OS may support multiple access level; however, the card issuer does not protect files using this feature.

- From the time the chip is created to the time it is deployed to the end-users, the chip changes many hands. The weakest link in the transport of this chip could cause a breach in smart card security.
- Many applications are implemented so poorly that compromise of one card could compromise the entire system.

Reference List:

1. Ayer, Ken. "Risk Management & Smart Cards." In *CardTech/SecurTech '99 Gateway to Practical Innovation*. Chicago: 1999.
2. Bovelander, Ernst. "Evaluations of Smart Card Based Security Systems - Is Your Smart Card Really Secure?" In *CardTech/SecurTech '95 Strategies for the Millennium*. Washington, D.C.: 1995.
3. Bovelander, Ernst, and Jan Pieters. "A Structured Approach to Smart Card Security." In *CardTech/SecurTech '96 Applications in Action*. Atlanta: 1996.
4. Garon, Gilles. "Overview of Smart Card Security and Standards." In *CardTech/SecurTech '95 Strategies for the Millennium*. Washington, D.C.: 1995.
5. Johnson, Lance. "Smart Card Chip Security: Classification and Evaluation." In *CardTech/SecurTech '97 The Art of Implementation*. Orlando: 1997.
6. Kocher, Paul. "Differential Power Analysis and Problems in Applied Cryptography." In *CardTech/SecurTech '99 Gateway to Practical Innovation*. Chicago: 1999.
7. Krueger, Julie. "The Evolution of Personal Tokens in a More Secure Future." In *CardTech/SecurTech '96 Applications in Action*. Atlanta: 1996.
8. Pieters, Jan. "External Attacks: An Overview." In *CardTech/SecurTech '00 Sizzling Solutions for a Digital World*. Miami: 2000.
9. Russell, James. "Smart Card Security – Threats and Safeguards." In *CardTech/SecurTech '99 Gateway to Practical Innovation*. Chicago: 1999.
10. Schneier, Bruce. "Security Threats in Smart Card Systems." In *CardTech/SecurTech '99 Gateway to Practical Innovation*. Chicago: 1999.
11. Thomasson, Jean-Paul. "Developments and New Architectures for High Security Smartcard Applications." In *CardTech/SecurTech '96 Applications in Action*. Atlanta: 1996.
12. Thomasson, Jean-Paul. "Smartcards and Fraud." In *CardTech/SecurTech '95 Strategies for the Millennium*. Washington, D.C.: 1995.
13. Van Gimst, Pascal. "Functionality Stress Testing of Smart Cards." In *CardTech/SecurTech '00 Sizzling Solutions for a Digital World*. Miami: 2000.